

Agroborealis

Volume 5, Number 1; July/1973



Institute of Agricultural Sciences
University of Alaska

A Review of Some Research in Progress

CHECK OUT
SEP 13



from the Director's Desk . . .

It isn't quite as easy to push your cart around the supermarket these days as it used to be. More people seem to be standing in the aisles, thoughtfully reading the labels and comparing prices. We've had one meat boycott and others may be coming, although nobody is really satisfied with the results of the first one. Everyone seems to feel that something will have to be done to get prices back into line, but the sad possibility is that food may never again be the bargain it was yesterday.

There are many possible reasons for high grocery bills—a late spring, a dry summer, a wet fall, or an outbreak of some new plant disease. Almost every year something is in short supply and costs a lot more, but we can always hope things will be better next year. Then there is inflation, although inflation should affect all prices equally and not single out food for special attention. Anyway, this, too, is temporary—we hope! But this year there has been a startling development that probably marks the beginning of a new era. This year Russia and China bought up every kernel of grain we could spare. If we'd had more, they would have taken it too.

What makes this sale doubly important is first, that the government allowed it to take place at all, and second, that the communists did not confine their purchases to bare survival needs. Never before have we felt it prudent to sell food to the other side. Now we have accepted as customers the most populous countries in the world. Not only that, much of the grain was bought for livestock feed, so apparently they are committed to upgrading their diets. This has big implications. It would take over 900,000 tons of grain to feed enough chickens to provide just one more pound of meat for each Chinese!

But this is only part of the story. We are already exporting food to much of the rest of the world. Of course this is nothing new—except that now we're getting paid for it, and that is different! What has happened is that "progress" has become widespread. Advanced technology is no longer our exclusive property. For instance, instead of the cheap toys they used to make, the Japanese now turn out some of the best radios, electron microscopes, cameras, tape recorders, motorcycles, and pollution-free cars in the world. This means that they and many other peoples now have more money to spend for better food. What most of them lack is land, and even those that have enough of this have never been able to beat the American farmer at his game. So now we can expect to sell food abroad on an ever larger scale.

Actually, we don't have much choice. Last year we spent \$6.8 billion more abroad than we took in. By 1980 we may be spending \$18 billion overseas for oil alone. By coincidence, \$18 billion is just about the value of the food the USDA thinks we could be exporting by 1980. In effect, we will be trading food for oil, and consequently our own food is going to cost more because greater demand leads to higher prices.

What does this mean for Alaska? Simply this: anything that raises the price of food relative to the price of other things is going to increase the margin of profit for farmers. This is Alaska's chance to turn a marginal enterprise into a solid source of income. We could start by trying to supply our own needs. Last year, Alaska imported over 50 million pounds of meat. Surely, at today's prices that should be market enough to sustain and encourage an industry of our own!

Horace F. Drury, Director
Institute of Agricultural Sciences,
University of Alaska

Agroborealis

JULY/1973

Volume 5

Number 1

Institute of Agricultural Sciences Staff Members

ADMINISTRATION

H. F. Drury, PhD.
Director Fairbanks
C. E. Logsdon, PhD.
Assoc. Dir., Prof. Plant Pathology . . . Palmer
S. H. Restad, M.S.
Executive Officer Palmer
J. G. Glenn
Administrative Assistant Fairbanks
B. L. Leckwold
Administrative Officer Palmer*

RESEARCH

L. D. Allen, M.S.
Assoc. Agr. Engineer Palmer
M. A. Barzee, M.S.
Asst. Prof. Agronomy Palmer
C. I. Branton, B.S.
Research Agr. Engineer Palmer
A. L. Brundage, PhD.
Prof. Animal Science Palmer
W. E. Burton, PhD.
Assoc. Prof. Economics Palmer
C. H. Dearborn, PhD.
Research Horticulturist Palmer*
D. H. Dinkel, PhD.
Assoc. Prof. Plant Physiology . . . Fairbanks
L. J. Klebesadel, PhD.
A.R.S. Location Leader
Research Agronomist Palmer*
W. M. Laughlin, PhD.
Research Soil Scientist Palmer*
J. D. McKendrick, PhD.
Asst. Prof. Agronomy Palmer
C. F. Marsh, M.S.
Research Economist Palmer*
P. F. Martin, M.A.
Research Soil Scientist Palmer*
W. W. Mitchell, PhD.
Prof. Agronomy Palmer
R. L. Taylor, M.S.
Research Agronomist Palmer*
W. C. Thomas, PhD.
Asst. Prof. Economics Fairbanks
Don C. Tomlin, PhD.
Asst. Prof. Animal Science Fairbanks
R. H. Washburn, PhD.
Research Entomologist Palmer*
F. J. Wooding, PhD.
Asst. Prof. Agronomy Fairbanks

* U.S. Department of Agriculture,
Agricultural Research Service
personnel cooperating with the
University of Alaska Institute of
Agricultural Sciences

Editor — Mary C. Langan

Agroborealis is published by the University of Alaska Institute of Agricultural Sciences, Fairbanks, Alaska 99701. A written request will include you on the mailing list.

To simplify terminology, trade names of products or equipment may have been used in this publication. No endorsement of products or firms mentioned is intended, nor is criticism implied of those not mentioned.

Material appearing here may be reprinted provided no endorsement of a commercial product is stated or implied. Please credit the researchers involved, and the University of Alaska Institute of Agricultural Sciences.

CONTENTS

1972 MEAT PRICES DOWN IN FAIRBANKS, UP IN SEATTLE

-Page 4

CONTROLLED ENVIRONMENT AGRICULTURE (CEA)

-Page 6

Agricultural climatologists meet in Alaska

-Page 8

Preserving Alaska's wood products by double diffusion

-Page 9

Can preserving by double diffusion be profitable in Alaska?

-Page 10

Nitrogen fertilization of Polar bromegrass

-Page 12

Soil testing as a research tool

-Page 13

Photoperiod/nyctoperiod pattern in autumn
critical to grasses in Alaska

-Page 14

Pumpkins, polyethylene and photoperiod

-Page 16

THE ALASKA PLANT MATERIALS CENTER—A new institution

-Page 17

Research progress with alfalfa in Alaska

-Page 18

NEW SWINE RESEARCH FACILITY

-Page 20

Comparison of oat-pea and barley-pea silage
as feed for dairy cows

-Page 21

Barley yields on summer-fallowed and stubble land

-Page 22

WHEAT RESEARCH IN ALASKA

-Page 23

Using native plant resources for conservation

-Page 24

Rotary plow gives yeoman service

-Page 26

New potato varieties for diversification and specialized markets

-Page 27

Controlling Alaskan insects without chemicals

-Page 28

PRIVATE CAMPGROUNDS IN ALASKA

-Page 30

Barzee new agronomist at Palmer

-Page 13

Basil Bensin dies at 91

-Page 26



Meat prices

- Page 4



Bromegrass survival

- Page 14



Alaska pumpkins

- Page 16



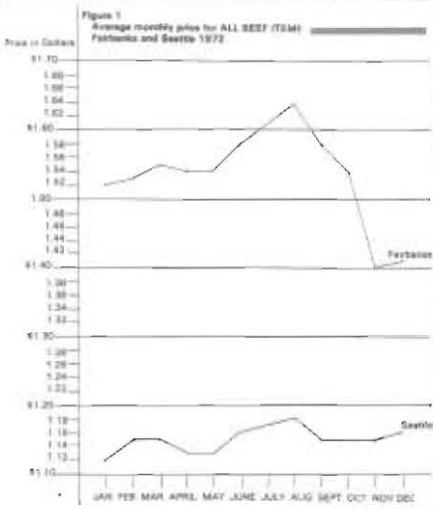
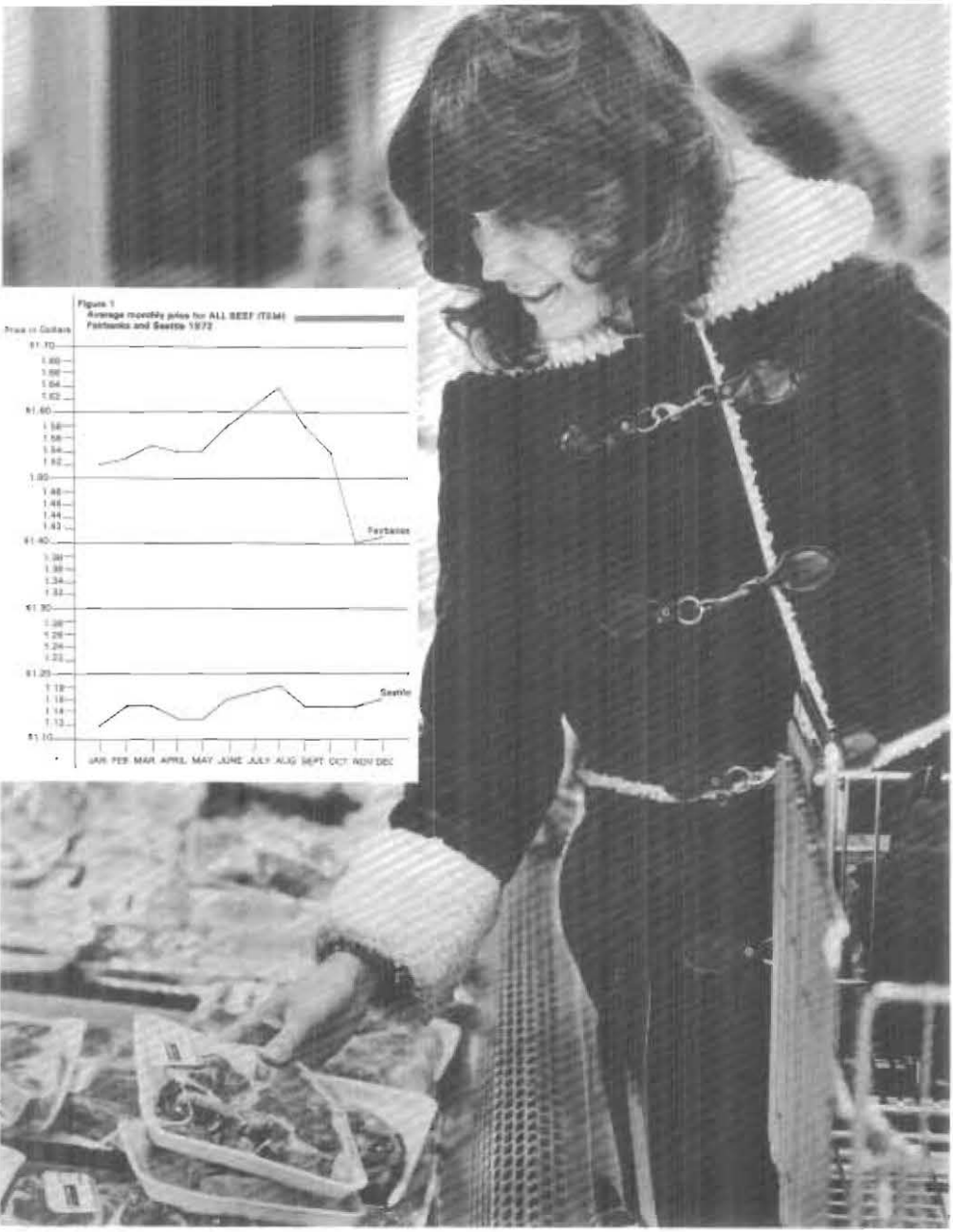
Harvesting hairgrass

- Page 24



ABOUT THE COVER . . .

They said "pumpkins won't grow in Alaska," but Donald H. Dinkel, associate professor of plant physiology, shows it can be done. He tells how on page 16. Photo by Bonnie Dinkel.



1972 MEAT PRICES DOWN IN FAIRBANKS UP IN SEATTLE

CHRISTOPHER A. STEPHENS
Research Assistant

WAYNE C. THOMAS
Assistant Professor, Economics

Food costs, especially those of meat products, contribute to the high cost of living in Alaska. The research presented

here was undertaken to determine just how much shoppers living in Fairbanks, Alaska were paying for selected red meat products compared with shoppers in Seattle, Washington. We felt that the research was particularly timely due to the dramatic rise in red meat prices experienced nationally during 1972. In this article we were interested in examining the magnitude of price

differences and the patterns of monthly price fluctuations.

Five cuts of meat were selected for this study: regular ground beef, chuck steak (bone-in), top round steak (boneless), T-bone steak, and pork loin chops. Data were collected each Tuesday throughout 1972, in three retail food chain-stores in Fairbanks and in Seattle.

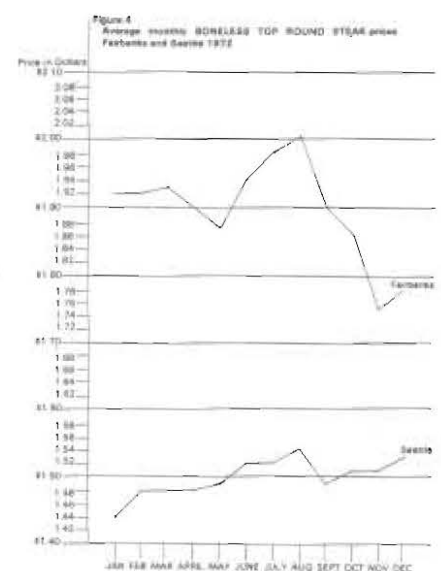
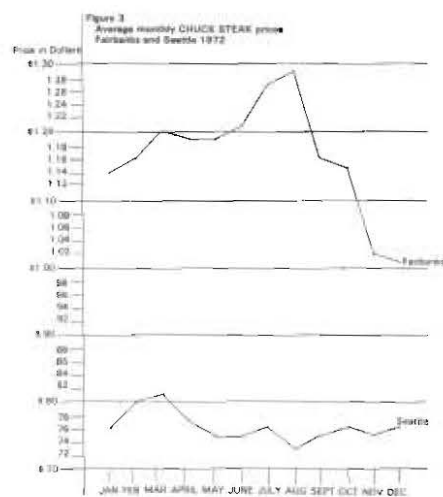
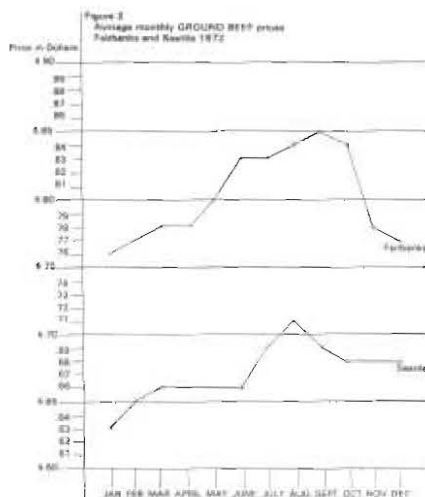
The food chains surveyed in the two cities received their meat from wholesalers operating in Northwest Washington state. Since the wholesalers were located in the same geographical area, it might be expected that wholesale prices for Seattle and Fairbanks had common price determinants. The most significant factors causing higher prices in Fairbanks were probably high transportation and overhead costs.

A note of caution should be expressed concerning this research. The analysis considered only five cuts of meat. The four cuts of beef selected may indicate trends for all beef prices, but generalizing to all pork prices from one cut (pork loin chops) may yield inaccurate results.

Average monthly prices for all beef items are graphically developed in Figure 1. Monthly price observations on individual cuts of beef and pork are presented in Figures 2 through 6. The average prices for all twelve months of 1972 for each meat cut and all beef items are shown in Table 1. The following discussion includes highlights of this research on selected meat price differences and trends in Fairbanks and Seattle.

By the end of 1972, Fairbanks consumers were paying seven percent less than they were at the beginning of the year for all beef items in this survey while Seattle shoppers were paying three percent more. From January

Table 1. Average Annual Meat Prices and Price Differentials (in dollars) — Fairbanks and Seattle, 1972				
Cut	Fairbanks price	Seattle price	Price difference	Percent difference
Ground Beef	.60	.67	.13	19%
Chuck Steak	1.17	.70	.41	54%
Top Round Steak	1.90	1.80	.40	27%
T-Bone Steak	2.29	1.67	.64	38%
All Beef	1.84	1.15	.38	34%
Pork Loin Chops	1.57	1.21	.36	31%



through August, the average Fairbanks beef price was \$1.56/lb (36 percent more than Seattle). After August the average price was \$1.48/lb (29 percent more than Seattle). This sharp decline in the Fairbanks average beef price was most likely due to intense price competition among Fairbanks' three food chain-stores.

Since the average beef price was derived from prices of four beef cuts, individual price breakdowns should give more insight into beef price movements. Ground beef prices in Fairbanks during 1972 averaged 19 percent (13¢/lb) higher than in Seattle. Fairbanks and Seattle price movements for ground beef displayed a noticeable degree of similarity. Although not exact, price changes were generally at the same time and in the same direction. Ground beef was the only beef item included in

this research in which the Fairbanks consumer was worse off price-wise at the end of the year than in the beginning. However, the Fairbanks shopper was still better off at the end of the year than was the Seattle shopper because ground beef prices in Seattle had increased even more than in Fairbanks.

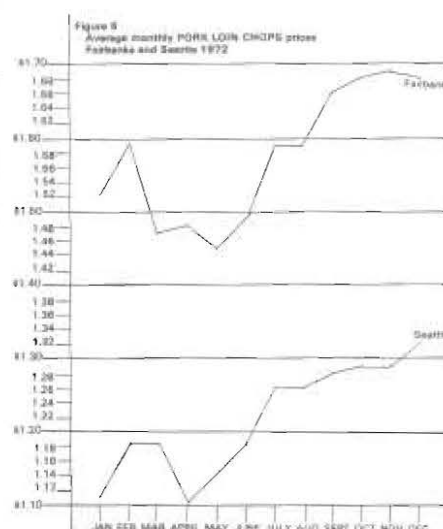
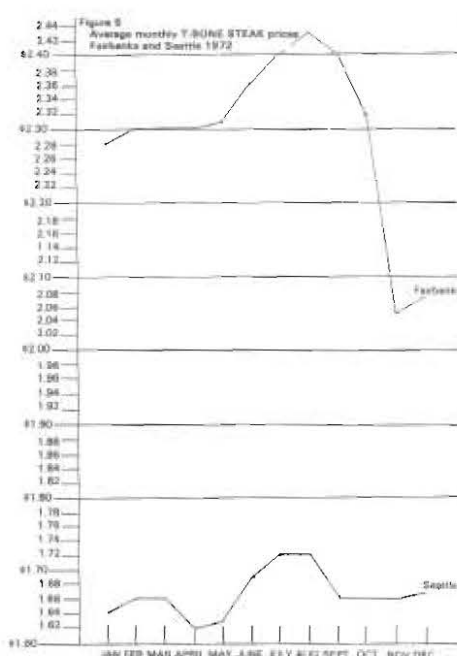
Fairbanks prices for each of the three steak cuts (top round, T-bone, and chuck) exhibited striking downward trends beginning in August and continuing through November, 1972. The Fairbanks consumer was faced with the happy consequence of paying 8 percent less for top round, 10 percent less for T-bone, and 13 percent less for chuck steak in December, compared with the preceding January. For these same three cuts, Seattle consumers were either paying the same or more in the December period versus the previous January. Between January and December the actual price per pound for these three cuts narrowed

between cities by 23¢ for top round, 24¢ for T-bone and 13¢ for chuck steak.

Fairbanks and Seattle price movements for pork loin chops were very similar. With few exceptions, pork chop prices in both cities increased markedly after May. The average yearly Fairbanks price for pork loin chops was 30 percent (39¢/lb) higher than Seattle.

During 1972 the Fairbanks shopper benefited from price reductions in beef steak. Also, the Fairbanks consumer was proportionately better off price-wise for ground beef, and was no worse off regarding price for pork loin chops compared with his counterpart in Seattle. More information is needed to analyze potential price movements and to determine if price differentials will continue to diminish in 1973 and beyond. As population and income levels increase in Fairbanks, competition between food stores should become more intense. Added to this is increased efficiencies apparent in transportation systems today and in the near future. This leads to speculation that over the long run, price differentials of meat products between Fairbanks and Seattle should decline.

This research is being continued through 1973 on an expanded basis in the hope that this data will aid the consumer in coping with the problem of increasing food costs. Prices for lamb, veal, bacon and ham, fowl, cold meats and additional pork items will be included. Prices are being collected in Anchorage as well as Fairbanks and Seattle. Also, data on wholesale meat prices will be collected and compared with retail prices to identify relationships between these two sectors of the market. ■





What will it take to produce Alaska's vegetables year-round?

CONTROLLED ENVIRONMENT AGRICULTURE (CEA)

DONALD H. DINKEL

Associate Professor of Plant Physiology

WAYNE E. BURTON

Associate Professor of Economics

CLAYTON R. OSUND

Assistant Professor of Plant Science, University of Idaho

Bright lights in the West Ridge greenhouse on the Fairbanks campus signal another research step toward year-round vegetable production in northern environments. High intensity discharge lamps (Figure 1) definitely produce a bright spot on the campus during the long, dark nights of Alaska's mid-winter. They are also producing initial data to be used in setting up a production system based on total

energy utilization. This is a concept in which electric power, heat, and carbon dioxide (CO_2) — produced in power-generating facilities using fossil fuels — will be used to grow plants in controlled environments.

Alaska is an excellent location for developing technology suited to total energy utilization, a concept which ensures maximal food production. There is an abundant availability of fossil fuels and there is a need for such maximal production. Anticipated development of various natural resources (particularly in the petroleum industry) indicate future social and economic development of Alaska. Also, the Native land claims settlement, the Rural Development Act of 1972, and continuing industrialization in Alaska's cities will stimulate development of the state.

Further, Alaska provides a desirable

location for both research and production development of Controlled Environment Agriculture (CEA) systems because of its location in northern latitudes, urgent need for development inputs particularly suited to northern climates, and evolving recognition of cultural, nutritional, and aesthetic benefits to be gained from CEA systems which subsequently may include ornamental, small fruit, and livestock products.

Alaska's present situation is characterized by inadequate production of its own edible crops. Field crop production has been restricted by negative attitudes, limited public research and service, and short frost-free seasons. Greenhouse production has been restricted by low temperatures, low light intensities, and short daily light duration during half of the year. Marketing field vegetables is

Table 1.
Yields in lb/sq ft/year of salad vegetables when grown in controlled environments.

Crop	Variety	lb/sq ft/year
Tomato	Homestead	7.6
Lettuce	Grand Rapids Forcing	8.7
Radishes	Champion	18.0
Turnips	Tokyo Market	48.0
Cucumbers	Femspot	21.0

The lettuce and radishes were grown under approximately 2000 f.c. of cool white fluorescent light. The tomatoes and turnips were grown under approximately 2000 f.c. of Lucalox and Multivapor High Intensity Discharge (HID) light. Cucumbers were grown under 2000 f.c. of Lucalox and Multivapor light for approximately five weeks.



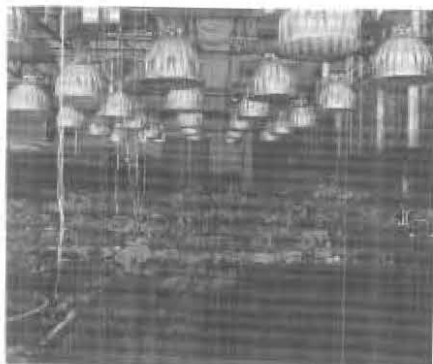


FIG. 1. Tomatoes and cucumbers being grown in a nutriculture system under High Intensity Discharge (HID) lamps at Fairbanks campus. Controlled Environment Agriculture (CEA) may eventually provide the means for economically feasible production of fruits and vegetables year-round in Alaska.

limited to a few weeks falling between mid-June and early September, with the exception of potatoes, cabbage, and carrots, which are stored. Cabbage and carrots encompassed less than 200 acres during the 1971 growing season. Greenhouse production has a somewhat longer season (mid-March to early October), but a 70-71 survey(1) indicated only limited emphasis (less than 20% of total sales reported) on salad-vegetables by commercial producers. However in the survey, interest was expressed regarding use of lights, CO₂, varieties, and numerous other topics which would extend the season of production. Only one large producer is presently known to be growing salad-vegetables commercially on a year-round basis. The predominance of present greenhouse salad-vegetable production is carried out by individuals to meet family subsistence needs.

A store shelf appearance survey in the Fairbanks community during the winter of 70-71 (1) provided some insight into the Alaska fresh and salad vegetable market. The following vegetables were found in fresh counters (not necessarily all in one store): tomatoes (bin, tube and cherry), cucumbers, radishes (red and white), lettuce (leaf, red leaf, romaine, head, and bibb), green onions, peppers (green, hot and pimiento), beets (with tops, without tops, and beet greens), turnips (with tops, without tops, and turnip greens), rhubarb, spinach, mustard, parsley, kale, swiss chard, chinese cabbage, zucchini, hubbard squash, peas, brussels sprouts, cauliflower,

carrots, broccoli, rutabagas, escarole, collard greens, cabbage (red and white), and asparagus. Survey observations were limited to those vegetables which had been previously determined as suitable for CEA production in Alaska.

Extensive economic year-round greenhouse or CEA production systems are not expected in the immediate future. A great deal of intensive research is needed first. Specific environmental requirements for optimum plant growth are not fully known. While one may strive for "optimum" conditions to produce lush foliage, large fruit, early maturity, most yield per dollar, or one of a multitude of other responses, we do not yet know how to produce maximum yields. To learn how to stimulate a plant to its maximum production potential will require the determination of a proper combination of all environmental and economic parameters. Some important parameters are: light (intensity, spectral distribution, and duration); atmosphere (CO₂ content, and oxygen); temperature; humidity; growing media (soils, and organic and inorganic media); growth nutrients; interaction of other organisms within the CEA environment; and fixed, operating, and marketing costs. We must learn to provide a set of environmental conditions precisely programmed so that no factor will limit or hold the plant back from reaching its built-in genetic capacity. We may even have to restructure the genetic composition of some plants to utilize the engineered capacity of CEA environments and production systems developed.

Under the auspices of the University of Arizona's Environmental Research Laboratory, recent work (2) with vegetable production in desert regions, using high temperatures and humidity, has shown that using partially controlled environments, growth potential can be many times greater than out-of-doors. Air-inflated, plastic-bubble greenhouses are used to maintain high humidity, temperature, and CO₂. Some of the yields in tons per acre for single crops obtained under these conditions include: tomatoes - 71, eggplant - 107, lettuce - 25, and cucumbers - 102. These yields compare with U.S. averages of 30, 8.25, 10.5, and 12 tons per acre respectively for good outdoor yields of the same crops. Potential year-round yields in these desert greenhouses are estimated at 196, 214, 300, and 450 tons per acre respectively with theoretical yields going above these estimates. Faster

growth rate, increased yield, and earlier maturity are factors accounting for the improved yields.

Further evidence that exceptionally rapid plant growth is possible comes from the Phyto-Engineering Laboratory of the U.S. Dept. of Agriculture (3) Special growth chambers there provide very high light intensities, and appropriate temperature, humidity, and CO₂ levels. With certain controlled levels of these environmental factors, some plants are found to grow at rates of from 10 to 50 times faster than in conventional greenhouses.

The experiments in the Fairbanks greenhouse are only a step in reaching the desired objectives in Alaska. Table 1 gives yields of the best producing varieties of several salad vegetable crops and the accompanying photo shows the vegetable quality. Preliminary studies have demonstrated that tomato plants will grow, set fruit, and ripen good tomatoes under high intensity artificial lighting. Yields were not high but only minor changes in technique will undoubtedly increase yields very substantially. Production of good quality radishes under lights in 21 days posed no major problems. Production periods of 17 to 15 days are in the offing. Leaf lettuce also grew well and produced marketable plants in 33 days.

It has been demonstrated that the production season of greenhouse

(Continued on next page)

FIG. 2. One pound European-type cucumbers ready for harvest on March 21st. The seeds were planted on January 19th, and grown under 2000 foot candles of Lucalox and Multivapor lights until February 21.



Agricultural Climatologists Meet in Alaska

C. I. BRANTON

Research Agricultural Engineer

The relation between agriculture and climate was the topic of a meeting held in Wasilla, Alaska in August of 1972. Twelve scientists from 11 states

traveled to Alaska to discuss results of climatological research. The conference was a meeting of a technical committee composed of representatives from Agricultural Experiment Stations in the North Central Region of the United States.

The committee members toured facilities at the Agricultural Institute's Palmer Research Station, and then traveled to Fairbanks to inspect Institute facilities on the University's main campus. The group conferred with members of the University's Geophysical Institute in Fairbanks, and also took advantage of the opportunity to observe at first hand interior Alaska's sub-arctic summer climate, unique in the thirteen states which make up the Region.

"Alaska's climatic resource is far different from that of the other twelve states in the region," said J. E. Newman, Professor of Bioclimatology at Purdue University.

Committee members agreed that in order to develop effective regional programs it is important for climatologists to understand more of Alaska's problems than it is possible to gain from just reading the literature.

The group were members of the North Central Region's Technical Committee NC-94, Committee on Climatic Resources, which works on problems such as air pollution, relating weather statistics to agricultural production, encouraging consideration of normal weather patterns in agricultural management, and developing and standardizing agricultural weather instruments and recording methods. The group has pioneered in adapting computer technology to the analysis of the large masses of data used to determine the probability of the re-occurrence of weather patterns. Computers are used to analyze data recording factors such as rainfall, evaporation of water, and energy flow through plants.

Attending the meeting from the University of Alaska's Institute of Agricultural Sciences were: C.I. Branton, a member of the committee, and H.F. Drury, S.H. Restad and C.F. Marsh.

Chairman J.M. Ramirez of North Dakota State University presided at the business meetings, and D.G. Baker, University of Minnesota was appointed acting secretary.

New officials elected for 1973 were: W.F. Lytle, South Dakota State University, Chairman; and R.E. Neild, University of Nebraska, Secretary.

S. H. Wittwer, Director of the Michigan State University Agriculture Experiment Station was present at the meeting as the Administrative Advisor, and A. J. Loustalot represented the United States Department of Agriculture's Cooperative State Research Service.

Some of the 12 scientists attending the meeting from outside of Alaska also brought members of their families and all committee members were enthusiastic about the discussions and the opportunity to observe Alaska's unique climate at first hand.

"We gained a real insight into the state," said L. D. Bark of Kansas State University.

Other members of the group were: W. L. Decker, Chairman, Atmospheric Science Department, University of Missouri; H. J. Mederski, Professor of Plant Physiology, Ohio State; G. E. Merva, Associate Professor of Hydrology, Michigan State; J. E. Newman, Professor of Agronomy and Head, Bioclimatology, Purdue; R. H. Shaw, Professor of Agricultural Climatology, Iowa State; R. K. Simons, Professor of Pomology, University of Illinois. ■

CONTROLLED ENVIRONMENT AGRICULTURE (CEA)

(Continued from page 7)

vegetables can be substantially extended in the near future even if the economic problems of year-round CEA production have not been completely worked out. This extended season could be made possible by using supplemental light in the greenhouse (or in a growth room) to produce transplants in midwinter. Only a few lamps are needed to produce transplants since the small potted plants can be grown at close spacing. In early spring, when sufficient light exists to support plant growth (about March 1), plants can be set out in the greenhouse. Tomatoes and cucumbers have responded quite well to this treatment. In fact, European parthenocarpic cucumbers weighing more than one pound each were first harvested on March 21 from plants seeded on January 19 (Figure 2). The plants were grown under lights until February 21 and from that time on they received only natural light. Tomatoes started under lights on January 20, and transplanted on February 20, were brought into production by April 21 when kept under supplemental light. Fruit production under natural greenhouse light was delayed until May 18.

It is highly probable that further research will reveal genetic materials, production methods, and technology that will provide a means for economically feasible year-round salad vegetable production in a totally controlled environment. In the interim, research in progress is providing a means for Alaska's commercial and home greenhouse producers to extend the growing season substantially. ■

REFERENCES

1. Wayne E. Burton. Fresh vegetable shelf appearance survey, 1970-71. Unpublished data.
2. Fontas, M.R., J. O'Toole and M.H. Jensen. Vegetable production under plastic on the desert seacoasts of Abu Dhabi. Proceedings Tenth National Agricultural Plastics Conference, November 1971. Chicago, Illinois. J.W. Courtner, Editor, University of Illinois.
3. U.S. Department of Agriculture. 1969. From seed to flower, fast...in controlled environments. *Agricultural Research* 17(9):3-5.



S.W. Wittwer, Michigan State U., overlooks a soil profile.

Preserving Alaska's Wood Products By Double Diffusion

LEE D. ALLEN

Associate Agricultural Engineer

When wood is used in contact with the ground, or in damp locations, its useful life can be significantly increased by using preservative treatment. In Alaska, posts, poles or pilings that have been commercially treated are sometimes unavailable or relatively expensive. However, methods are available for farmers or small commercial operators to produce preservative-treated posts at a cost lower than that of shipped-in, pressure-treated material. One of these methods, the double-diffusion process, is effective, yet is inexpensive, simple, and does not require excessive equipment. This process was evaluated in 1972 at the Institute of Agricultural Sciences Matanuska Research Farm.

Two Approaches

There are two basic approaches to treating wood; one utilizes petroleum solutions for dry wood, and the other uses water solutions for freshly cut material. Oil-based treatments have been used successfully in Alaska on dry wood, but green or improperly seasoned wood cannot be treated satisfactorily with oil-based preservatives since the moist wood resists penetration of the oil. Water solutions, however, can be used successfully on green or partially dried wood, but are unsatisfactory for dry wood. The cells of green or partially dried wood are still in an active state and the chemicals in the water-based solution diffuse into the living wood cells and are distributed in the sap stream.

The water-based method is most effective for green round posts, poles, or pilings, because the sapwood on the outside of the tree conducts the water solutions better than heartwood. For the method to be uniformly effective, the trees must be in a living, healthy condition when cut. Unhealthy trees, especially those with scars where dried wood is exposed, do not absorb water solutions properly.

The Double Diffusion Process

Since chemicals used to treat unseasoned wood are water soluble, they can, in time, be leached from the post by rain or soil moisture. One

method used to prevent the preservative from leaving the wood under wet conditions is called the double-diffusion process (3,5). In this process a water soluble chemical is allowed to diffuse into the wood fibers. After adequate soaking time, the post is put into a second solution of chemicals that will react with the first to form an insoluble preservative. Since the first chemical is already in the wood, the chemical reaction takes place there, and the reaction product is formed in the wood. The insoluble preservative prevents fungus or insect damage to the wood and cannot be washed out, making the treatment very long lasting.

Our tests in 1972 were based on treating-schedules that produced the highest chemical retentions in Alaskan species (6), as determined by the U.S. Forest Products Laboratory. Several combinations of chemicals have proven satisfactory for the double diffusion process (1,2). It was decided that copper sulphate (CuSO_4) would be most suitable for the first treatment. A combination of sodium chromate (NaCrO_4) and arsenic acid (H_3AsO_4) was used for the second treatment. This treatment was applied to four locally abundant species: white spruce, balsam poplar (cottonwood), aspen (poplar) and birch.

Preparing the Posts for Treatment

The experiment was planned to include green posts and posts at various levels of drying. The posts for partial drying were cut in the winter of 1971-72. They were cut, peeled, and stored at freezing temperatures so they would not dry out.

The bark of the posts cut in winter or early spring was hard to remove and had to be peeled away with a draw knife or ax. Green posts cut in summer peeled easily by stripping the bark off by hand, once it was started with a spike. The bark was more difficult to remove from posts cut near the end of July.

Posts were removed from the freezing storage to warmed storage for periods of 2 to 4 months for partial drying. A copper identification tag was attached to each post. Just before treating, all posts were incised with a chisel-pointed hammer (Figure 1) in the groundline area to increase the chemical penetration in this critical area. This permitted sampling both incised and

unincised areas of the same post for chemical analysis.

Treating the Posts

Posts were tested for moisture content (Figure 2) and sorted into batches based on these tests. Some batches were made up of freshly cut green posts, and two batches were made of sawed 8x8s and 2x10s of spruce and balsam poplar. The posts were treated in plywood tanks (Figure 3) and held completely submerged by wood blocks placed under steel bars which were inserted through holes near the top of the tank.

The copper sulphate was applied to the posts either in a 10% unheated solution or a 6% solution heated to 165° F and allowed to cool overnight. The second solution for all batches contained 5% sodium chromate and 5% arsenic acid at ambient temperature, but the time of soaking was either 1 or 2 days.

Between solutions, the posts were washed to prevent any of the copper sulphate solution from being carried over into the chromate-arsenic solution, where a precipitate is formed when the solutions combine. A careful final washing removed any excess chemical from the surface, thereby preventing formation of a powdery residue on the surface of the posts when they dried.

(Continued next page)

Fig. 1. Preservative treatment of wood can significantly increase its useful life. Here posts are incised with a chisel-pointed hammer before treatment by the double-diffusion process. Treating tank can be seen at right.



Can Preserving By Double Diffusion Be Profitable In Alaska?

CHARLES F. MARSH
Research Economist

The old saying, "There's many a slip twixt the cup and the lip," is quite true when studying the economic feasibility or predicting the chances for success of many things we attempt to do in Alaska. Whether we like it or not, economics plays a very important role in the success or failure of most business ventures. Let us take a brief look at the economics involved in treating wood products by the double-diffusion method.

What is the double-diffusion method? It consists of soaking green wood, first

in one chemical solution, and then in a second chemical solution. The chemicals used are water soluble and diffuse into the free water in the wood by capillary action. Here the chemicals react with each other to form a relatively insoluble, non-leachable compound that is toxic to fungi and insects.(1)

In comparison, the most commonly used pressure-treating method is much more complicated and expensive. With this method, penetration of the wood is obtained by forcing the heated chemicals into the wood by hydraulic or air pressure up to 200 pounds per square inch.

The double-diffusion method requires

less expensive equipment than is required by the pressure-treating method, and relatively low-cost chemicals. The chemicals used can be shipped dry, in light, inexpensive containers, to the place of treatment. Thus, the method appears especially promising for areas such as Alaska, which has no pressure-treating facilities and where shipping costs are a major part of the cost of obtaining treated timber products. For further details about the double-diffusion method, chemicals used, and procedures followed, see the foregoing article in this issue of *Agroborealis*.

Before examining the other economic

(Continued from page 9)

Additions of chemical and water were made periodically to the tank. Diffusion of chemical into the wood reduced the strength of the solution, and evaporation of water from the surface increased it. A hydrometer was used to check the strength of solution, and additions were calculated to maintain proper solution level and concentration.

The average absorption of chemicals (determined by dividing the total additions to the solutions by the total number of posts treated) indicate that about 0.49 pound of copper sulphate was absorbed in the first soak, and that 0.23 pound of sodium chromate and 0.22 pound of arsenic acid was absorbed in the second soak. At this rate of absorption, the chemical cost was 40 cents per post.

The observation area, with posts set on a 4-foot grid (Figure 4) will permit us to determine the service life of the posts. It will be 10 to 20 years before this determination can be made from observation of failures in actual service.

Chemical tests can determine the



Fig. 2. The moisture content of each post was determined with the electronic moisture meter prior to treatment of the posts.



Fig. 3. Iron bars hold the posts submerged. Once the bars are inserted over the posts, the posts can easily be forced down and more blocks added.

amount of preservative absorbed by the posts and therefore give an indication of the protection provided by the treatment, and samples of incised and unincised portions of the posts are being analyzed.

The average total chemical retention of nearly one pound per post indicates that most of the posts absorbed the solution adequately. Staining tests on sawed sections indicate that penetration was excellent with aspen and balsam poplar, good with birch, and fair penetration was obtained with spruce. Incising near the groundline tended to increase chemical absorption in hard-to-treat posts. Good penetration occurred on sawed timbers of balsam poplar, but very poor penetration was noted on sawed spruce timbers. Aspen or balsam poplar will likely outlast spruce or birch as home-treated posts.

Limited previous experience in Alaska with the double-diffusion process indicates that if the wood can be made to absorb the chemical, good resistance to decay can be achieved.

Most of the batches of posts treated and set in 1954 have experienced no

failures after 18 years of exposure to Alaska soil and climate. The double-diffusion method has been tested in other areas (4) and was placed in the same class as pressure treatments, with estimated life of over 40 years.

The good average chemical-absorption rate obtained in this test, the encouraging indications from the previous test in Alaska, and the experience of researchers in other areas support the conclusion that the double diffusion process can be applied successfully to Alaskan woods, and that the treated posts are long lasting in Alaska. Locally treated Alaskan species could safely replace a portion of the market currently filled by imported metal or treated wood posts. ■

REFERENCES

1. Beechler, R. H. 1953. [Rev. 1958 and 1963.] How to treat fence posts by double diffusion. FPL Report 1955. 8 pp.
2. Beechler, R. H. and H. G. Roth. 1964. The double diffusion method of treating wood. A Review of Studies. Forest Products Journal 14: 171-78.
3. Blew, J. Oscar Jr. and Francis J. Champion. 1962. Preservative treatment of fence posts and farm timbers. USDA Farmers Bulletin 2049. 34 pp.
4. Blew, J. O. and H. L. Davidson. 1967. Comparison of wood preservatives in Mississippi post study. U.S. Forest Service Research Note FPL-01.
5. Brenton, C. I. and Harry Wimmer. 1956. Preserving wood for Alaska's farms and homes. University of Alaska Extension Bulletin 803. 8 pp.
6. Gjovalk, L. R., H. G. Roth, and H. L. Davidson. 1972. Treatment of Alaskan species by double diffusion and modified double diffusion methods. Forest Service Research Paper FPL 182. 20 pp.



Fig. 4. Posts were planted to evaluate service life.

aspects of treating wood products in Alaska, it is important to answer two questions. First, is there a demand for treated wood products in Alaska? Second, are there adequate stands of native forestry materials available in areas where treating plants could be located?

The first question is difficult to answer with definite figures for prices and quantities. It is true that treated materials are used by a number of State and Federal agencies, private businesses, and individuals—including farmers, homesteaders, and homeowners throughout Alaska. More would probably be used, however, if a lower cost supply were available. The high cost of imported materials has no doubt greatly affected its use.

For the 3-year period 1969-71, an annual average of 4,317 tons of timber, posts, poles, and piling were recorded as having moved through various ports in Alaska.⁽³⁾ No breakdown is available for specific items; however, it is assumed that most of these materials were treated. The treated materials used have been pressure treated in the lower 48 states and shipped to Alaska. At present no treated wood products are produced in the State.

The Alaska State Housing Authority (ASHA) has proposed to build 5,000 to 6,000 new houses for the native population of Alaska in outlying villages during the next 5 to 6 years. In these areas, piling is used for support. From six to eight piles would be required per house. If it is assumed that 5,500 of these houses are built, and that eight piles are used per house, the treated

Table 1. Estimated cost for farm treatment of 400 posts, Palmer, Alaska, 1973.

Item	Cost Factor	Total Cost
Labor:		
Cutting, trimming and hauling	40 hr. @ \$3/hr.	\$120
Preparation and treatment	80 hr. @ \$3/hr.	180
Cutting equipment ^a	13 1/3 hr. @ \$6/hr.	80
Tractor and Wagon ^b	10 hr. @ \$3/hr.	30
Preservatives	50¢ per post	200
Miscellaneous ^b		30
Total		\$640

^a Cost per hour covers both fixed and variable costs.

^b Includes cost of barrels, heating of treating solution, use of small tools, etc.

piling needed will total 44,000 piles (8,052 tons²) for the proposed houses alone. New highways and roads that are either under construction or in the planning stages will insure a continued demand for guardrail posts, bridge timbers, and other wood materials. As the title to more State and Borough land is transferred into private ownership, the demand for treated logs, piling, posts, and poles for houses, cabins, and fences should increase. The demand for treated poles for power and telephone lines should continue strong and increase as these facilities are extended to more of the outlying centers throughout the State. A potentially sizable market could develop for wood materials treated by the double-diffusion method, if these materials are acceptable.³

In answer to the second question, inventories by Federal and State foresters indicate that there are rather large stands of cottonwood, spruce, poplar, and birch throughout Alaska that are suitable for posts, piling, and other such wood products. Initially, spruce may be the primary material used, as it is generally more acceptable in the trade.

To be competitive with other States, Alaska must produce treated wood products at a cost equal to or less than that required to ship these products into the State. Based upon the best available information, cost estimates were made for two types of operations:

a. A home operation in which the farmer uses his own labor in cutting and treating material from his own land.

b. A commercial operator who runs a treating plant and contracts with someone else for raw material to be cut and delivered. The operator probably could do this most economically in conjunction with his lumber or sawmill business.

The cost estimate for the home operation is shown in Table 1.

The estimated cost per post was \$1.60 (\$640 ÷ 400 posts). According to this estimate, a farmer could produce treated fence posts at a lower cost than he would have to pay for pressure-treated posts (\$3.00 to \$4.00) or steel

posts (\$2.00) that have been shipped into Alaska from the Pacific Northwest. Steel posts, although quite durable under most conditions, become somewhat brittle at extremely low temperatures and are rather easily broken under stress. No cost data are available from other States for wood materials treated by the double-diffusion method. Although some materials are treated by this method in the southern States, only small quantities are treated in other areas. None have been imported into Alaska.

Table 2. Capital investment to treat 20,000 piles

Peeling machine	\$4,000
Pressing machine	4,000
Lift truck (used)	5,000
End trimming machine	3,000
Grinding and planing equipment	4,000
Shed for treating tanks (weather track)	6,000
Concrete treating tanks	20,000
Land, 5 acres	5,000
Total	\$61,000

The cost estimate made for a commercial operator was for one who might wish to contract with an agency like ASHA to supply 20,000 piles (3,660 tons)² during a 3-year period. It was assumed that he would amortize his investment in 3 years. A capital investment of \$51,500 was needed. Operating costs were \$305,586. A breakdown of the land, buildings, and equipment needed are shown in Table 2, and Table 3 shows the cost estimate for the commercial enterprise.

The estimated cost per treated pile was \$15.28 (\$305,586 ÷ 20,000), which did not include the shipping cost to point of use. In comparison, pressure-treated piling shipped to Alaska from the lower 48 States costs \$20 per pile f.o.b. Anchorage. No cost estimates were made for the pressure-treating method. The cost of the equipment needed to set up a commercial enterprise in Alaska for pressure-treating wood could be within the range of \$200,000 to \$250,000.

(Continued on page 29)

Table 3. Estimated cost for a commercial enterprise to treat 20,000 wood piles, Palmer, Alaska, 1973

Item	Cost Factor	Total Cost (3 years)
Raw material	25¢/cubic ft.	\$120,000
Preservatives	\$4/cu yd	80,000
Heating of treating solution	50¢/cu yd	10,000
Labor (one man full time)	\$5/hr.	37,440
Real estate taxes	15 mil levy X value of land (\$9,000) X 3 yr.	225
Taxes on equipment, tanks, and shed	2-3% of inventory value (\$45,500) X 15 mil levy X 3 yr.	1,298
Maintenance	2% of original cost (\$5,500) per year X 3 yr.	2,790
Overhead costs	Insurance, legal, office, accounting, etc.	5,000
Interest on land and salvage value of equipment ^a	8%/yr. X 3 yr.	3,432
Amortization of capital investment minus land value minus salvage value of equipment ^b	8%/yr. X 3 yr.	43,304
Sales Promotion		2,000
Total		\$305,586

^a Salvage value of equipment was figured at 20% of original cost.

^b Total investment of \$51,500 minus \$5,000 (value of land) minus \$9,300 (salvage value of equipment) equals \$37,200. This amount amortized at 8% X 3 years equals \$43,304.

¹ A "pile" is an individual member of the supporting material that is identified by the type as "piling."

² Treated spruce piles averaging 23 feet along with a diameter of 8 inches at the tip and 10 inches at the butt, and weighing approximately 366 pounds were used to calculate the tonnage.

³ Posts pressure-treated with 50 percent of coal-tar creosote and 50 percent of used crankcase oil, pentachlorophenol (approximately 3 percent and 5 percent) in used crankcase oil, watergas tar, and zinc-methyl arsenite, and those treated by the double-diffusion process with copper sulphate and sodium arsenate should last longer than 40 years on an average" (2).

REFERENCES

1. Beechler, R. H. and H. G. Rath. The Double-Diffusion Method of Treating Wood: A Review of Studies. Forest Products Journal, April 1964, p. 171.
2. Blew, J. O. and H. L. Davidson. Comparison of Wood Preservatives in Mississippi Post Study. (1967 Progress Report). U.S. Forest Service, Forest Products Laboratory, Madison, Wisc., U.S. Forest Service Research Note FPL-01, April 1967, p. 16.
3. Department of the Army, Corps of Engineers. Waterborne commerce of the United States: Part 4, Alaska District, Calendar years 1969-71.

Nitrogen Fertilization of Polar Bromegrass

WINSTON M. LAUGHLIN
Research Soil Scientist

PAUL F. MARTIN
Research Soil Scientist

GLENN R. SMITH
Research Assistant

A fertilizer should produce the greatest yield of the highest quality crop as economically as possible. Many of our fertilizer experiments are designed to determine optimum rates. Information obtained from these experiments enables us to estimate fertilizer nutrients removed with the crop and those remaining in the soil in an available form. Thus, a balance sheet may be prepared showing fertilizer applied, uptake (the amount taken up by the crop), and the amount recovered from the soil after the harvest.

In May 1970 a field experiment involving five rates (0, 100, 150, 200, and 250 lb N per acre) of two nitrogen (N) sources (ammonium nitrate vs. urea) was established on a uniform stand of Polar bromegrass. The location of the experiment was on a shallow phase of Knik silt loam in the Fairview area of the Matanuska Valley. Half of the plots received all their N in the spring. The remaining plots received half of the N in May and half after the first harvest in June.

All plots received 150 pounds of phosphate (P_2O_5) as treblesuperphosphate, and 200 pounds of potash (K_2O) as sulfate of potash. The brome was harvested twice in 1970. Fertilizer treatments were repeated in May 1971 and the plots again harvested. Three soil samples were taken from each plot: at two inches (from zero to two inches), at four inches (from two to four inches) and

	Yield (oven-dry) Tons/A	N uptake Lb/A	Percent recovery of Applied N*	
Application				
Single	2.24a†	103b	53b	96a
Split	2.78a	114a	61a	97a
Source				
Ammonium nitrate	2.78a	128a	69a	95a
Urea	2.24b	88b	45b	97a
Rate, lb/acre				
0	0.29d	10d	—	101a
100	1.99c	89c	58b	90a
150	2.68b	106b	62a	92a
200	2.62b	117b	53b	98a
250	2.88a	142a	63b	95a

†Values within each column followed by the same letter are not significantly different at the 5% level of probability according to Duncan's Multiple Range Test.

*N in plant - N in plant from N treatment $\times 100$
N applied

**Sum of N in plant and NO_3^- -N and Kjeldahl N in soil Aug 26 $\times 100$
Sum of N applied and NO_3^- -N and Kjeldahl N in soil May 26

at six inches (from four to six inches). Samples were taken before fertilization in May, 1971, in May, 1972, and again after removal of the second bromegrass crop in August, 1971. These samples were extracted with Morgan's solution(1) and then analyzed for nitrate-nitrogen (NO_3^- -N), phosphorous (P), and potassium (K). Kjeldahl nitrogen was determined in the soil and in forage samples from each bromegrass harvest.

Table 1 summarizes effects of N fertilization upon total yield, N uptake (or removal from the soil by the bromegrass) and N recovery. Compared to a single application, half the N in the spring and half after the first cutting increased yield, uptake of N by the bromegrass, and the recovery of applied N. Ammonium nitrate produced greater yields, supplied more N to the plant, and produced greater recovery of applied N than did urea. Each N increment increased brome yields and the N uptake with the exception of the increase from 150 to 200 lb. N/acre.

Application of more than 150 lb N per acre tended to reduce the recovery of

applied N. The recovery of available N (estimated by measurements in the plant and measurements of the total amount in the soil before fertilization and after harvest) was not influenced significantly by time of application, source, or rate. Practically all N was accounted for in this manner. About the same amount of N was left in the soil at the end as was there at the beginning of this 2-year study.

Table 2 presents available NO_3^- -N, P, and K at 2 inches, 4 inches and 6 inches at the three sampling dates. The values shown are the averages of 96 measurements. The amounts of available P and K decreased as time passed and as depth increased. Although NO_3^- -N was highest within the surface 2 inches at all dates, only on May 17 was the 6-inch increment significantly different from the 4-inch sample. Available NO_3^- -N and P remained about the same at all three sampling dates. Available K reflects plant use by August 26 and the subsequent release during the winter of nonexchangeable K to exchangeable K May 17.

Available NO_3^- -N at these three sampling dates was not influenced significantly by the source or the time of application. Nitrogen fertilizer failed to move downward in the soil profile even at high rates.

Available P and K in the soil following the second harvest tended to be less in plots receiving ammonium nitrate rather than urea, and on those receiving the split rather than the single N application. This decrease probably resulted from the higher yields with these treatments; that is, removal of P and K by the plant was greater.

Rainfall in the Matanuska Valley is of low intensity. Surface runoff is rare except during periods of snowmelt when the ground is frozen. Thus there is little or no loss of applied fertilizer by runoff. Low rainfall intensity coupled with small amounts (rarely exceeding 8 inches during the growing season) results in little, if any, downward water movement through the soil profile. Analyses of the soil samples from these three depths showed no measureable downward movement or accumulation of applied fertilizer nutrients. ■

Table 2.
Effect of sampling depth on available NO_3^- -N, P, and K on
Knik silt loam (shallow phase) on three sampling dates.

Sampling depth	May 6, 1971			Aug 26, 1971			May 17, 1972		
	NO_3^- -N	P	K	NO_3^- -N	P	K	NO_3^- -N	P	K
Inches									
0-2	4.7a†	14.9a	180a	5.6a	15.6a	168a	5.4a	16.0a	205a
2-4	3.3a	8.5b	129b	3.9b	7.9b	146b	4.5b	6.2b	169b
4-6	3.4a	5.5c	121c	5.52	5.8c	138b	3.1c	3.4c	150c

†Means within each column followed by the same letter are not significantly different at the 5% level of probability.

REFERENCE

1. Martin, P.F. 1970 Alaska Agricultural Experiment Station "Quick" soil tests. Laboratory methods and procedures. Alaska Agr. Expt. Sta. Mimeo. 11 p.

Soil Testing as a Research Tool

PAUL F. MARTIN
Research Soil Scientist

Soils are part of a natural biological system, and no one has ever been able to force a biological system into a rigid classification or mold. Conditions of climate and soils in Alaska are very different from conditions in more temperate regions. They also vary greatly within the State. A sound basis for determining needed soil amendments is necessary for land management practices in Alaska. Present-day homestead development and cropping activities are moving into new areas. Soils in these new areas are unlike any previously encountered. Furthermore, intensive cropping in existing agricultural areas may lead to nutrient deficiencies other than nitrogen, phosphorus and potassium.

The main purpose of Alaskan soil-testing research is to estimate levels of available plant nutrients in Alaskan soils. Soil productivity and plant responses are estimated using a three-phase process. First, initial estimates are obtained from chemical tests of soil samples taken from the field. Then, suspected nutrient inadequacies are tested in the greenhouse. In the third phase, significant findings from the laboratory and greenhouse are then tested in the field. Later, the results of these investigations are statistically analyzed, interpreted and reported to promote the general adoption of improved practices.

It is often difficult to correlate soil tests with crop response. This is especially true in the analysis of soils for trace elements. There is usually a time lag before soil test results reflect application of fertilizer and lime. Application of 10 or more pounds of phosphate per acre may change the soil test value for available phosphate only one pound per acre.

Soil test values also show seasonal variations. This is especially true of potassium soil tests. Researchers have compared the testing for soil potassium to "shooting at a moving target." Immediately after a rapidly growing forage crop is removed, available potassium may be extremely low. But even with no potassium added, these values may be more than three times higher the following spring.

Should a grower rely on experience or "cook book recipes" for choosing plant



food? The answer is a definite NO! Soil testing is very useful in identifying areas of toxicity as well as defining areas deficient in specific nutrients. Soil testing has made it practical for fertilizer manufacturers to formulate fertilizers containing the nutrients most needed for their particular market areas.

Since crops vary in their food requirements and ability to obtain various essential elements, soil test results that might be considered ideal for one crop may be inadequate for another. Tests can aid in determining the suitability of soils for adaptation to specific crops. For example, a soil having a pH in the acid range would be better used for producing blueberries rather than peas.

A nutrient may be deficient because another is present in excess, thus interfering with the feeding balance. If one is lacking or overabundant, the plant's feeding capacity is thrown out of

balance. When this happens plant growth is disrupted, or may even cease.

Therefore, recommendations for one fertilizer nutrient must be based on the presence of sufficient amounts of all other nutrients needed for optimum plant growth. Maximum benefits from any one nutrient can be obtained only if supplies of others are sufficient. For example, if a soil test indicates that a soil needs a nitrogen fertilizer, maximum returns from applications of nitrogen will be obtained only if adequate amounts of other essential nutrients, such as phosphorous, are present.

Interpretation of soil tests must consider other factors that affect crop growth. Such factors include seasonal weather differences, time of planting, seedbed preparation, crop variety adaptability, weeds, insects, and plant diseases. Some of these factors can be controlled by the farmer; some cannot.

Environmental and managerial factors are of great significance when making interpretations from soil test information. Soils showing the same general fertility level from soil tests may respond differently from one year to the next when fertilized with the same fertilizer. Also, soil test results from one place cannot be applied directly to other places. To arrive at any valid conclusion as to management of a given soil and its relative fertilizer requirement, one must interpret the soil tests in relation to previous experimental greenhouse and field trials. ■



Barzee New Agronomist at Palmer

Milton A. Barzee joined the staff of the Institute of Agricultural Sciences at Palmer in January. An Assistant Professor of Agronomy, he will be doing rehabilitation research in connection with oil-field activities and the proposed 800-mile trans-Alaska pipeline, and he will also be studying problems of weed control and certain physiological aspects of crop growth.

Barzee's position is supported by contracts granted the University, and he is currently studying temperature restrictions on seed germination and the effects of oil spills on land.

A native of Idaho, he obtained a bachelor's degree in crop science from Utah State University, a master's degree in weed control from Ohio State University, and is obtaining his doctor's degree in crop physiology from Oregon State University.



Figure 1.

Facilities used to impose four different daily light/dark (photoperiod/nyctoperiod) patterns on grass rows. The four treatments were applied for eight weeks before freeze-up in mid-October. Rows in the photo are identified as follows:

- NN — Normal nights (nine hours at start, lengthening to fifteen hours at the end of the eight-week period);
- IN — Nights were interrupted using floodlights (end-wall of enclosure in photo is in raised position);
- LN — Nights were lengthened by cutting off daylight;
- SN — Nights were shortened by floodlighting during early evening.

Photoperiod/Nyctoperiod Pattern in Autumn Critical to Grasses in Alaska

L. J. KLEBESADEL
Research Agronomist

Grasses, to most Alaskans, are casually accepted as a natural part of our environment. Green in summer, under the snow in winter — something that is just "there" like the trees, sunlight, soil, and other things we encounter every day.

Even the lowly grass, however, needs more than just sunlight, water, carbon dioxide, and nutrients in order to exist and persist. Grasses, like other perennial plants, also need specific cyclic changes in the environment that occur on a seasonal basis. These changes activate vital physiological processes within the plant that are necessary for its survival. One such process is the annual preparation for the rigors of winter.

Adaptation

Grasses ordinarily thrive in their native environment because they have evolved there. Through thousands of years, the grasses' ancestors resided under the same relatively unchanging set of seasonal climatic conditions. As a result, inner physiological processes of

the continuing progression of plant descendants have achieved over the centuries a certain "harmony" or adaptation to that environment.

However, environments differ all over the world. Depending on location on the earth's surface, growing seasons are long or short, precipitation is heavy or light, winters are mild or severe, and so on. Therefore, a plant adapted to one area of the earth's surface may or may not be adapted to living in another place in the world, depending on similarities or differences between the two environments.

When the new settlers in America brought crops (in the form of seeds) from Europe, the change in environment for many of those crops was slight. When planted in the New World, many European grasses (timothy, orchardgrass, brome grass, etc.) found conditions quite similar to those of Europe. As a result, those grasses thrived and thus became important forages in the United States.

Furthermore, when American farmers moved westward with the tides of migration and settlement, they also took their crop seeds with them. In most instances, the introduced forage grasses grew in the western states with little difficulty.

Grass	Variety	Latitude of adaptation (degrees N.)	Scientific name
Brome grass	Native Alaskan	61.5	<i>Bromus pumilius</i>
	Polar*	61.5	<i>B. pumilius</i> x <i>B. inermis</i>
	Southland	38.12	<i>B. inermis</i>
Kentucky bluegrass	Nugget*	61.0	<i>Poa pratensis</i>
	Marion*	44.12	<i>Poa pratensis</i>
Red fescue	Arctic*	61.5	<i>Festuca rubra</i>
	Rainier	45.12	<i>Festuca rubra</i>

*Developed and released in Alaska by the Institute of Agricultural Sciences and U.S. Department of Agriculture.

Since this procedure worked well through history — that is, taking crops from Europe to America, and from the eastern U.S. to the western shores — then it logically should have been possible for farmers to take crops north from the conterminous 48 states and use them with equal success in Alaska. Unfortunately, that has not been the case.

Poor Winter Survival

One of the most significant deficiencies noted in midtemperate-adapted biennial and perennial crops when they are grown in Alaska is marginal to inadequate winter-hardiness.

Why should this be? Why should it be possible to grow crops successfully

thousands of miles east and west of their area of adaptation, yet they fare poorly when taken only a few hundred miles northward?

Is it because winters are more severe in Alaska? Not really. Although Alaska's winters start earlier and are somewhat longer than those in the northern U.S., low winter temperatures in Montana, North Dakota, Minnesota, and Wisconsin are quite similar to, or colder than, those prevalent in south-central Alaska.

Hardiness Development

Seasonal climatic changes are known to cause perennial plants to prepare for winter. If in midsummer, Alaskan grasses, trees, and other perennial plants were exposed to low temperatures they would suffer severe cold injury or death. Yet those same plants tolerate low temperatures during winter with no damage. The reason for this winter tolerance of freezing temperatures is because protection is afforded by important physiological changes that occur within all perennial plants in northern areas prior to the start of winter. These changes are referred to

collectively as the development of winterhardiness or cold hardiness, and they are induced to occur in plants by external stimuli—in other words by seasonal climatic changes in the environment.

The most obvious changes in the environment before the onset of winter are a trend of generally lowering temperatures, shortening of daily photoperiods (daylight hours), and lengthening of nyctoperiods (duration of nights). These factors are known to operate together to cause plants to develop winterhardiness. The period of time during which relatively short photoperiods (long nyctoperiods) prevail prior to the onset of winter conditions is very much shorter at subarctic than at midtemperate latitudes. Is this difference in length of "conditioning" period sufficient to have an adverse effect on the winter survival of midtemperate-adapted plants when they are grown in southcentral Alaska? An experiment was designed to resolve this and other questions.

The same experiment had a second objective beyond considerations of winter survival. It has been noted in many earlier studies that Alaskan-

adapted grasses produce numerous seed heads when grown locally, but that many introduced grasses ordinarily do not. Many management variables, such as time-of-planting, fertilizers applied, and so on, can affect the heading of grasses. However, as with their winter survival, the ability of grasses to produce seed heads depends also on environmental suitability or adaptation. Therefore, the second experimental objective was to learn if different daily light/dark patterns for several weeks prior to the onset of winter conditions might influence numbers of seed heads produced the following year.

Experimental Procedure

Three common perennial grass species were compared: bromegrass, Kentucky bluegrass, and red fescue (Table 1). Within each species, a variety adapted to Alaska and a variety adapted to midtemperate latitudes (mid-continent U.S.) were used. Native Alaskan bromegrass was included, also.

Grass rows were planted in late June, the experimental facilities shown in Figure 1 were assembled, and

(Continued on page 29)



Figure 2. Photo showing beneficial effect of lengthened (15-hr.) nyctoperiods the previous autumn on winter survival of midtemperate-adapted Southland bromegrass. (Top): Severely winter-injured Southland where it had been exposed to normal subarctic nyctoperiods the previous autumn. (Bottom): Good winter survival where Southland had been conditioned prior to winter with lengthened nyctoperiods more like those occurring before winter in its area of origin.



Figure 3. Photo showing harmful effects of lengthened (15-hr.) nyctoperiods the previous autumn on heading of subarctic-adapted native Alaskan bromegrass. (Top): Native bromegrass averaged 15 seed heads per foot of row the year after row was exposed to normal subarctic light/dark pattern. (Bottom): The same grass averaged 1 seed head per foot of row where it had been exposed to lengthened nyctoperiods the previous autumn for 8 weeks prior to freeze-up.

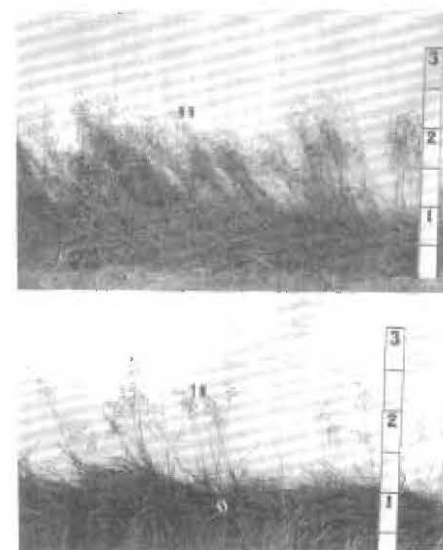


Figure 4. Effects of normal versus normal-but-interrupted nyctoperiods prior to freeze-up on seed-head production by subarctic-adapted Nugget Kentucky bluegrass the following year. (Top): Where nyctoperiods were unaltered for 8 weeks prior to freeze-up, Nugget averaged 152 seed heads per foot of row. (Bottom): Where nyctoperiods were interrupted by 90 minutes of illumination near mid-point, Nugget averaged only 12 seed heads per foot of row.

Pumpkins, Polyethylene and Photoperiod

D. H. DINKEL
Associate Professor of Plant
Physiology



It has been shown that 3 or 4-foot wide strips of clear polyethylene film laid on the soil will raise soil temperature enough to permit production of many warm season garden crops in Alaska.⁽¹⁾⁽²⁾ The polyethylene allows the sun's rays to warm the soil and also retards the escape of heat. Soil heating is produced because of the entrapped layer of still air, reduced moisture evaporation, and lower transmission by the polyethylene of heat radiation from the soil, as compared to its transmission of incoming solar radiation.

Many varieties of sweet corn, cucumbers, winter squash, pumpkins, tomatoes, eggplant and peppers that could not be otherwise grown can be

successfully produced with the clear polyethylene soil covering. Sweet corn varieties that mature the earliest at lower latitudes are also the varieties that produce marketable ears first when grown through clear polyethylene at northern latitudes. However, this relationship does not hold true with some of the other warm-season garden crops. The cucurbits (cucumbers, squash, pumpkins, etc.) are a notable exception. Although all varieties of the cucurbits, that have been tested to date, produce significantly greater vegetative growth when grown through clear polyethylene film, not all have shown an increase in flowering that leads to the production of mature fruit. For instance, such squash varieties as Table Queen, Royal Acorn, Bush Ebony, Waltham Butternut and Buttercup — all listed in seed catalogs as maturing in 90 days or less — have not produced mature fruit in Alaska. On the other hand, Golden Hubbard, Baby Hubbard, Warty Hubbard, Kindred and Golden Nugget, which are considered long-season varieties, have produced mature fruits at Fairbanks. Successful fruit maturation can be related to the time that female flowers are produced, as shown in Table 1.

Most members of the cucurbit family produce male flowers at a number of nodes prior to the development of female flowers. The tendency to produce male flowers first is referred to as the staminate phase of growth, and the later period when female flowers are produced is called the pistillate phase. It has been shown (3) that high temperatures and long days (long photoperiods) tend to keep many members of the cucurbit family in the staminate phase, whereas low

Table 1. Date of first female flower production of several squash and pumpkin varieties during 1971 when grown with or without clear polyethylene.

Variety	Date of 1st plants with female flowers	Days after seeding to 1st female flowers	Yield of mature fruit (lbs./acre)	
			Without polyethylene	With polyethylene
Squash				
Boston Marrow	July 29	33	10,375	71,795
Fairfax Hybrid R	July 3	37	18,052	25,898
Table Queen	July 20	54	0	0
Improved Warty Hubbard	July 3	37		81,460
Blue Hubbard	July 7	41	0	42,330
Kindred	June 28	33	0	42,330
Golden Hubbard	June 28	33	0	34,000
Waltham Butternut	July 23	57	0	0
Pumpkins				
Cherokee Bush	June 27	31	18,008	24,828
Cinderella	July 7	41	0	0

temperatures and short days speed up the development of the pistillate phase so that female flowers are produced after a much smaller number of nodes have developed.

The various varieties of squash and pumpkins differ in their specific response to the long photoperiods so that some varieties produce female flowers earlier in Alaska than others. The varieties that produce their female flowers earlier have the greatest chance of producing mature fruit before frosts occur in the fall. The combination of the right variety and the use of polyethylene makes it possible to mature pumpkin and squash fruits in the short seasons found in Alaska. It is expected that further improvements will be made with plant breeding and selection for varieties that produce female flowers in the long days, and that respond to the increased soil temperatures produced by clear polyethylene. ■

REFERENCES

1. Dinkel, D.H. 1966. Growing sweet corn in Alaska's cool environments. Alaska Agri. Exp. Station, Bulletin #39.
2. Dinkel, D.H. 1966. Polyethylene mulches for sweet corn in northern latitudes. Proc. Amer. Soc. Hort. Sci. 89: 497-503.
3. Nitch, J.P., Kurtz, E.B., Liverman, J.L. and Went, F.W. 1952. The development of sex expression in cucurbit flowers. Amer. J. Bot. 39:32-42.



THE ALASKA PLANT MATERIALS CENTER -- A New Institution

CHARLES E. LOGSDON
Associate Director

Urban and industrial Alaskans need increasing amounts of green plant materials. New approaches for supplying them must be found. Conservation practices and revegetation were once thought to be mainly the concern of the farmer and farm community. In Alaska today, however, there is a new awareness of the need for environmental protection, an increasing interest in lawns and landscaping, the federal highway requirement for healing of construction scars, the environmental impact statement on the pipeline, and many other facets of ecological interest. These needs put increasing pressure on the seed industry and the nursery industry of the state to provide more and specially-adapted plant materials.

The 1972 Alaska State legislature, in seeking a solution to this increasing statewide problem, passed House Bills 8 and 9 authorizing the establishment of a Plant Materials Center for the State. This new law reads in part:

"The Department of Natural Resources, in cooperation with the Institute of Agricultural Sciences, shall establish and maintain a plant materials center.

"The objectives of the plant materials center are to:

- (1) assemble, evaluate, select, and increase plant materials needed in soil and water conservation, agriculture and industry, and maintain genetic purity of these materials;
- (2) increase promising plant materials for field scale testing;
- (3) test the promising materials in field plantings on sites that represent soil and climatic conditions not found at the center;
- (4) maintain and provide for increase of basic seed stocks of plant materials for agricultural and conservation interests;
- (5) make seed and plant materials available (for a fee if necessary) in such a manner as to avoid monopolistic control of basic seed stocks of these

materials and encourage the development of a seed industry;

- (6) support but not duplicate activities carried on by state or federally funded research programs in the state;
- (7) prepare, publish and disseminate a summary report on all studies as they are completed.

"The department shall cooperate with the Institute of Agricultural Sciences and the United States Soil Conservation Service by a formal memorandum of understanding and may cooperate with any department or agency of federal, state or local government, research organization, or other organization concerned with conservation or agriculture."

A site for the Center has now been obtained. This is a former dairy farm near Bodenbug Butte in the Matanuska Valley. Much of the land is already cleared; and although some work will be needed to prepare land sufficiently weed-free for this type of operation, it is hoped that some plantings will be made in the spring of 1973.

The initial staff of the Center will consist of a manager, his assistant, mechanic, and clerk. The manager will supervise the operation. He will be responsible for program development and for reporting to the people of the state through written reports and through on-the-site demonstrations. He also will be responsible for coordinating the interests of participating agencies and groups. His assistant will be involved in the actual work of maintaining the genetic and mechanical purity of varieties and selections. The maintenance mechanic will not only care for the field and seed processing equipment, but will also aid the assistant manager in the growing and care of selected varieties. The clerk will perform the usual clerical functions and may assist with seed analysis. This core group, with the possible help of a limited amount of seasonal labor, will be able to perform all of the basic functions of the Center. Other, more specialized personnel may be required in the future as the Center program expands beyond grasses and grains to include various horticultural crops, small fruits, ornamentals, and forestry species.

In order to assure that the Center is responsive to agency and public needs, an Advisory Board is to be appointed from the Department of Natural Resources, the Institute of Agricultural Sciences, Soil Conservation Service, Agricultural Research Service, Association of Soil Conservation Subdistricts, and Alaska Crop Improvement Association. The Advisory Board will approve programs and reports of the Center. In addition, the law requires an annual accounting to the legislature of the operation of the Center, including all receipts and disbursements. This provides a very broad group through which the public can make its particular wishes known.

Field equipment and seed processing equipment has been ordered, and upon delivery, the work of the Center will begin. Before work begins, the Advisory Board will meet with Center personnel to approve the first year's program and to develop a statement of policy to govern future operations.

Although the Center is located in the Matanuska Valley, its responsibilities are statewide, both from the standpoint of assembly of plant materials and from the standpoint of wide-scale field demonstrations. Demonstrations may be conducted in cooperation with the Institute of Agricultural Sciences at their various locations, or it may be done by Center personnel on leased acreages. The exact manner in which it is accomplished will depend on the most effective methods of getting information to the public in the shortest time.

The Alaska State Plant Materials Center is a new concept. Although it resembles to a large extent the Soil Conservation Service Plant Materials Centers in some of the other states, the Center in Alaska has a much wider responsibility. The Alaska Center will increase not only materials useful in conservation, but will deal with all kinds of plant materials. It will, in addition, perform certain functions and services (as an intermediary between research programs and the public) that in other states are generally provided by the seed industry or state nurseries, or special service groups.

The Alaska Plant Materials Center is an infant institution. With nourishment and encouragement, however, it will grow to maturity and will serve Alaska's developing agriculture, conservation, and industry. ■



Winter survival of Alaskan A-syn.B. and *M. falcata* in comparison with rows of twelve poorly adapted alfalfa varieties from outside Alaska. Rows planted June 10, 1968, photographed June 29, 1969 at the Matanuska Research Farm. (See key below.)

Research Progress With Alfalfa in Alaska

L. J. KLEBESADEL
R. L. TAYLOR
Research Agronomists

The most conspicuous deterrent to growing alfalfa in Alaska has been the uniformly poor winter survival here of varieties imported from other areas.

Most new farmers in Alaska include alfalfa in their first plantings, convinced that advice to the contrary from old-time farmers or from extension or research personnel is naive or unfounded. Each new farmer is certain that his special variety of alfalfa that did well "back home in Minnesota" (or Montana, New York, etc.) has not been tried here and will do well. Experience has shown that people rarely can be dissuaded from trying alfalfa, so it is then recommended that they try a small planting to prevent their wasting a large investment only to discover anew that alfalfas from elsewhere fare poorly here.

History in Alaska

Interest in growing alfalfa in Alaska started long ago, based on the successes noted with this crop in the midwest and western states. First seedings of alfalfa were made at the early Alaska experiment stations in the years indicated: Kenai in 1904, Copper Center in 1906, Rampart and Fairbanks in 1909, Kodiak and Matanuska in 1919.(1) Almost without exception, all types and varieties evaluated

winterkilled completely the first winter or made very poor survival and were eliminated the second winter.

A multitude of alfalfa varieties and selections from all areas of the globe has been evaluated experimentally over many years by researchers in Alaska. No commercially available varieties from elsewhere in the United States, Canada, or from any other areas of the world have been found adapted and satisfactory for use under Alaskan conditions.

The major exception to this poor pattern of winter survival was a yellow-flowered species, *Medicago falcata*, which is sometimes referred to as "Siberian" alfalfa. Some plants of this alfalfa can be seen growing along various roadsides in agricultural areas of Alaska where it has escaped from cultivation. Many small-plot and field trials have been conducted on farms in various parts of Alaska with the seed of *M. falcata* supplied by (then) the Alaska Agricultural Experiment Station, the Soil Conservation Service, or the Cooperative Extension Service.

Despite the excellent winter-hardiness of this yellow-flowered alfalfa in Alaska, several factors have precluded its adoption for forage production. Chief among these are: (a) no seed is available commercially, (b) seed yields are low, (c) seedling vigor is very poor making establishment difficult, and (d) it competes poorly with vigorous forage grasses.

Extent of Use

Alfalfa has been utilized as a forage crop for thousands of years — for so long that its earliest use in Asia predates written history. From its center of origin in southwestern Asia, alfalfa has been spread by man's activities during many centuries to the six major continents, where it now ranks as one of the world's most important forage crops. In South Africa, Australia, New Zealand, and most of the countries of Europe, this crop is called lucerne.

Several characteristics of alfalfa have contributed to its popularity as a forage crop. With appropriate soil and climatic conditions, adequate establishment and good management, alfalfa provides high yields of nutritious, palatable forage.

KEY

1 Cossack (Siberia)	8 Ladak (India)
2 Triesdorfer (Bavaria)	9 Alfa (Sweden)
3 Mallard 50-50 (Minnesota)	10 <i>M. falcata</i> (Alaska)
4 Rhizoma (British Columbia)	11 Liachtenstein (Bavaria)
5 Mark II (New York)	12 Dawson (Nebraska)
6 Talent (Oregon)	13 Dominor (Minnesota)
7 A-Syn.B (Alaska)	14 Scout (California)

The leafy herbage is high in protein and important mineral elements. Alfalfa is a long-lived, drouth-resistant crop, noted for its valuable soil-improvement characteristics including the symbiotic incorporation of atmospheric nitrogen into plant tissues, as is accomplished by most legumes. Frequently grown in association with grass, alfalfa can be grazed or harvested and preserved as silage, haylage, hay, wafers, pellets, or dried meal. A well-developed alfalfa seed production industry in the western states insures availability of top-quality seed.

Despite the present round-the-world distribution of alfalfa, culture of this perennial legume is confined for the most part to temperate latitudes. Relatively little alfalfa is grown in subarctic agricultural areas of the world, that is, areas as far north as Alaska. Certain varieties of alfalfa are grown successfully in the Scandinavian countries, lands similar in latitude to Alaska. However, crops there are subjected to less winter stress than occurs here, and those alfalfa varieties fail in Alaska.

Hybridization

Researchers working with alfalfa in Alaska have tried several approaches to making alfalfa culture successful here. In addition to the aforementioned evaluation of a great many varieties from all over the world, hybridization between different alfalfa types has been employed. This course was pursued primarily by G. W. Gasser (now deceased) and H. J. Hodgson, former agronomists here. Crosses were made between the extremely winterhardy "Siberian" (*M. falcata*) alfalfa and the

more desirable variegated type. Hybrid progeny, backcrossed to the yellow-flowered Siberian parent, resulted in a yellow-flowered strain, A-syn.A, intermediate in most characteristics between the two parental types. Although very winterhardy (see table), it possesses several of the same shortcomings of the *M. falcata* parent and therefore has not been increased for use.

Soil Amendments

Response of alfalfa to various soil amendments has been evaluated on a considerable number of soil types in different areas of the state, principally by W. M. Laughlin, soil scientist here. Liming has generally improved growth of the crop where soils were acidic (usually below pH 5.0), but winter survival was seldom enhanced significantly by this means.

Numerous fertilizer elements (e.g. molybdenum, boron, sulfur) have been added, both to the soil and in water solution to alfalfa foliage, all with little effect on alfalfa performance. Various ratios of the major fertilizer elements, such as nitrogen and potassium, have been evaluated with only negligible differences in growth or survival of alfalfa.

Significant progress in promoting better growth and higher forage yields of alfalfa in the Tanana Valley was made through frequent, heavy applications of potassium fertilizer. However, stands thinned rapidly and potassium variables showed essentially no effect on winter survival of the two alfalfas compared(4).

Soil heating and different strains of *Rhizobium* bacterial inoculant were tried with no appreciable effect on performance of the crop. The numerous "blind alleys" encountered and related here are typical of the research process. Although each failed to resolve the problem, the negative results to each approach served to eliminate that factor from further consideration as a deterrent to alfalfa culture in Alaska.

Root System

Numerous old, surviving plants of alfalfa in the Matanuska Valley have been dug for examination of the root system by the authors and others. Almost invariably the main taproot of each plant had been broken off and healed over a few inches below the crown. The resultant shallow root system consisted almost entirely of strongly developed lateral roots.

Theorizing that injury to the taproot probably occurred during winter when plant recovery from injury would be poor, taproots were severed experimentally in midsummer. Although plants recovered well from the artificial injury, and the root systems showed change toward lateral predominance by autumn, winter survival was not enhanced.²

Natural Selection

The most significant advances in alfalfa work in Alaska have emerged from collaboration between agronomists and the natural selection process as imposed through winter stress. This work was initiated at the College Experiment Farm near Fairbanks by former agronomists B. M. Bensin (now deceased) and J. C. Brinsmade. The few surviving plants from each of many alfalfa plantings were "rescued" and transplanted to a spaced-plant crossing nursery. There, the desirable physiological characteristics of the few plants that were able to survive the Alaskan winters were perpetuated. Hives of honeybees, maintained adjacent to this small nursery, interpollinated these plants possessing apparent genetic inclination toward subarctic adaptation. Numerous annual seed crops so derived provided a new synthetic strain of probable but undetermined value for Alaska.

To assess the extent to which progress had been made toward better adaptation to subarctic conditions, which should result in improved winter survival in Alaska, this new strain was compared with about three dozen varieties from Canada, the conterminous states, and Europe.(3) The results of five large, spaced-plant tests over two winters in the Tanana and Matanuska Valleys confirmed that the new Alaskan strain possessed winterhardiness superior to that of all other varieties compared from outside Alaska (see table).

Indications are that its improved winter survival is due to the superior ability of plants of the new strain to store high levels of food reserves in the roots prior to winter and to withstand low-temperature stress.

Significant Progress

This new strain, now called A-syn.B, represents considerable progress toward adapting a leguminous crop with

(Continued next page)

Percent winter survival of Alaskan and other alfalfa strains following winters of 1968-69 and 1969-70 at the Matanuska Research Farm and College Research Center, in south-central and interior Alaska, respectively. These data were derived from 5 separate tests.*

Alfalfa variety or selection and origin	Average percent winter survival	Alfalfa variety or selection and origin	Average percent winter survival
Alaskan		Conterminous USA:	
1. <i>M. falcata</i>	91 a	13. Teson	49 c
2. A-syn. A	88 a	14. Travon	38 af
3. A-syn. B	75 b	15. Ladel-R5	32 gh
		16. Roseman	30 gh
		17. Culver	28 hj
		18. Grinn	28 hj
		19. Ladel	26 ik
Canadian		20. Cosack	25 jd
4. Roemer	46 cd	21. Canaga	24 j-m
5. Rembler	42 de	22. Dawson	22 k-n
6. Rhinoma	41 de	23. Mark II	22 k-n
7. Beaver	26 fg	24. Scout	22 k-n
		25. Vernal	20 l-o
		26. Gekab 123	19 p
		27. Flammort	19 p
		28. Globe 440	19 p
		29. Dominor	18 q
		30. Narragansett	17 n-q
European		31. Ranger	17 n-q
8. Tuna	35 fg	32. Mallard 50-50	16 oop
9. Liechtenstein	32 gh	33. Talent	8 r
10. Triadorler	30 gh	34. Lebranten	3 r
11. Alfa (Scandin)	14 qj	35. Calif common	2 r
12. Du Fura	12 s	36. Colvade-90	2 r

*Within each column, any two values not followed by the same letter differed significantly (5% level); any two values followed by the same letter were not significantly different (Duncan's Multiple Range Test).

NEW SWINE RESEARCH FACILITY

DON C TOMLIN

Assistant Professor, Animal Science

A new swine research building at Fairbanks is essentially complete, some two years after the money was provided by the 1970 University bond issue.

The basic design of this building is as modern as anything being used in the south 48 states. The key feature is the manure disposal system; an in-the-floor aerobic oxidation ditch. The ditch is 8 feet wide, 2½ feet deep, and built in a large oval. It is covered with aluminum slats, so pigs can walk over it. A paddlewheel, 2½ feet in diameter, set across the ditch circulates the waste around the ditch to keep the solids in suspension, and also aerates the waste slurry to oxidize the pollutants. A fair amount of water is used in this system, as the maximum solids content for efficient operation of the ditch is 2 percent. A standpipe beyond the wheel maintains a constant depth of 18 inches and carries the overflow to a sump, from which it is pumped to an outside lagoon. Once a year the lagoon contents will be spread on the farm fields.

(Continued from page 19)

high forage value to Alaskan climatic conditions. Another improved strain (A-syn.C), with promising winter survival characteristics, has been derived from a different genetic base of variegated alfalfa at the Matanuska Research Farm. A. C. Wilton, former agronomist here, contributed significantly to the development of this selection. Seed stocks of these strains currently are very small and it will be some years before they will become available for plantings beyond experimental studies. Meanwhile, efforts to improve upon these strains and to incorporate alfalfa into Alaskan forage production continues. ■

REFERENCES

1. Irwin, D.L. 1945. Forty-seven years of experimental work with grasses and legumes in Alaska. *Alaska Agr. Exp. Sta. Bul.* 12, 48 p. (Out of print).
2. Klebesadel, L. J. 1964. Modification of alfalfa root system by severing the taproot. *Agronomy Journal* 56:359-361.
3. Klebesadel, L. J. 1971. Selective modification of alfalfa toward acclimatization in a subarctic area of severe winter stress. *Crop Science* 11:609-614.
4. Klebesadel, L. J., and J. C. Brinmade. 1966. Response of two alfalfas (*Medicago sativa* L. and *M. falcata* L.) to time and rate of potassium application in the Subarctic. *Agronomy Journal* 58:545-549.

The oxidation ditch will remove more than 90 percent of the Biological Oxidation Demand (pollutant capacity) in the manure, including all of the odor-producing potential. This is the first and only oxidation ditch in the far north designed for research on animal waste disposal, a serious problem for an expanding livestock industry here.

However, for most Alaskan hog producers today, in their present isolated conditions, deep anaerobic lagoons are much cheaper and quite adequate, as long as they do not overflow into a stream. The odor-eliminating oxidation ditch was considered essential for this barn, which is located a few yards uphill of the Nenana Highway and a mile upwind from both the center of campus and a fairly dense residential area.

Probably the biggest problem encountered in animal barns in the North is the build-up of humidity, quite often to the point that it "rains" inside the barn. This is a serious fault, not only because of the physical discomfort to both animals and workers, but also because of the increase in respiratory diseases. In this building, a continuously operated fan forces air into a large perforated polyethylene tube. As the humidity in the barn reaches a pre-set level (about 55-60% at 60 degrees F), an exhaust fan comes on to pull some of the humid air outside. This creates negative pressure in the barn, causing louvers in the wall near the mouth of the polyethylene tube to open and admit fresh outside air, which is mixed in the tube with inside air before being released to the rest of the barn. The perforated tube also avoids any direct draft onto the pigs. There is an additional exhaust and a large separate intake to cope with summer heat.

The barn contains four farrowing crates for sows and their litters up to 3-4 weeks of age, a number of other pens, and a chute and scales for individually weighing the pigs. There are two features that would not be found in commercial hog operations; an open area on the east end of the barn planned for special research set-ups, and an enclosed, raised walkway with separate entrance along the north side. The Experimental Farm has a lot of visitors through the warm half of the year. The walkway will allow visitors to see the entire pig operation without carrying any potential disease problems to the

pigs, or disturbing operations in the building.

The initial research planned for the new barn is nutritional evaluation of triticale grain (wheat X rye hybrid) for pigs. We are particularly interested in protein quality (amino acid balance). Mr. J. L. Brossia, a graduate student in Animal Science, will be conducting digestion trials with growing pigs, and also with weanling mice. The latter are sensitive to protein quality, and are useful for preliminary studies. This type of work will probably be repeated many times in the future, as the agronomy staff obtains or develops new cereal varieties for interior Alaska.

Interest has been expressed in the potential for Alaska-produced fish-meal and fisheries-byproduct meals for use in some pig rations. If the problems of processing and availability in-State can be worked out, this would be an appropriate subject for study. Fish meal is a high quality protein supplement and is used in considerable quantities for pig production in England.

Another potential research project is to find ways of reducing baby pig mortality. A recent report from Canada, including records on nearly 7,000 pigs, shows a death rate from birth to 20 weeks of over 25 percent. Here in Alaska, we have heard of Yorkshire gilts producing 15-16 pigs on their first litters, but weaning only 10-12 pigs. If even half of these lost pigs could be saved and marketed, it would boost profits of our hog producers. Research workers in North Carolina and Nebraska have developed machines to house and feed surplus and orphan pigs from birth to 3 weeks, but the machines have been very expensive. We hope to simplify the ideas used in the machines, reduce costs, and come up with something of benefit to Alaska's hog producers.

Finally, development of management practices for maintaining pigs in year-round confinement will be a continuing process in the new barn. There has been a lot of progress made in this field in the last 5-10 years, particularly in the North Central States. However, it would be wrong to assume that everything is already known on the subject. As more experience is gained, more problems have come up. We hope that use of this new barn will provide new information to pass along to Alaska's pig producers. ■

Comparison of Oat-Pea and Barley-Pea Silage as Feed for Dairy Cows

A. L. BRUNDAGE
Professor, Animal Science

Corn silage, which provides the major forage component in dairy cattle rations in many parts of the United States, is not a feeding option on Alaskan dairy farms. Commercially available varieties of silage corn are not adapted to the short, cool summers of Alaska without costly cultural modifications, such as the use of plastic mulches. The Alaskan dairyman is restricted to using perennial grasses such as bromegrass, timothy, and indigenous species, and annual crops such as small grain-field pea combinations for silage. Ensiling is the preferred method of roughage preservation on most dairy farms because cool, damp weather during the summer and autumn makes hay production difficult and uncertain.

The annual forage mixtures of choice have been combinations of forage oats and field peas for many years. Barley has been limited in its suitability for silage because the adapted varieties were awned. These serrated barley awns, or beards, presented a potential hazard to the consuming animal. Even after ensiling, the awns can penetrate the tissues of the mouth and facilitate the entry of the causative organisms of actinobacillosis and actinomycosis (lumpy jaw, big jaw, wooden tongue). Weal, however, a new variety of hooded barley was released by the University of Alaska and the U.S. Department of Agriculture in 1972. (2) Forage producers in Alaska will soon have the option of using either oats or barley in their annual silage crops.

In May, 1971, small acreages of barley/peas and oat/peas were seeded at 50 pounds of viable seed of each component per acre to provide material for a feeding trial with lactating dairy cattle. Both seedings were fertilized with 200 lbs of commercial fertilizer (10-20-20) per acre. The forage mixtures were swathed and field-chopped for ensiling during August 16th through 18th when the oats were in the milk stage of maturity and the barley in the late-milk to early dough. The barley/pea mixture yielded 2.56 tons and the oat/pea mixture 2.29 tons of dry matter per acre.

The silos were opened on 2 November 1971 and the silage fed to eight lactating dairy cows during the ensuing 3½ months in a switchback feeding trial.(1) In this type of feeding trial, the

cows are paired according to stage of lactation, age, and level of production; and the members of each pair randomly assigned to two groups. One group is fed ration A (barley/pea silage) for 35 days, then switched to ration B (oat/pea silage) for 35 days, and finally switched back to ration A for another 35-day period. During the same time, the other group is fed ration B, A, and B. The first five days of each period are reserved for adjustment to new rations and the remaining 30 days are used to measure animal performance, such as milk production, weight change, and feed intake. Each animal's performance during the first and third period is compared with that during the second period to provide an estimate of differences on the two rations. In this way, each cow is actually compared against herself to evaluate the two diets. This permits meaningful comparisons of rations with a small group of dairy cows which differ considerably in their genetic parameters for milk production and feed intake.

Table 1. Feed intake and animal production per day

Date	Oats/peas	Barley/peas
Feed intake (lbs)		
Concentrate		
As fed	8.2	8.2
Dry matter	7.3	7.3
Silage		
As fed**	84.8	75.4
Dry matter	23.8	23.8
Animal production (lbs)		
4% milk	35.5	35.1
Liveweight**	1252	1241
Weight change*	+0.3	+0.4

*Differences are significant at the 5% level of probability

**Differences are significant at the 1% level of probability

Feed intake and animal production data are listed in Table 1. The oat/pea forage mixture had higher moisture content at ensiling and during feeding than the barley/pea mixture. The cows ate significantly more of the oat/pea silage as it was fed, but equal amounts of the two silages on a dry-matter basis. Daily milk production was comparable. Liveweights maintained and daily weight changes were significantly higher on the barley/pea silage.

Results of chemical analyses are listed in Table 2. Although analytical values for several of the constituents in the two silages were significantly different, these differences are small from a practical consideration and the silages could be considered quite similar.

Both the feeding trial and the laboratory data show that oat/pea and barley/pea silages are comparable. The barley component of barley/pea forage

Table 2. Chemical analyses of barley/pea and oat/pea silages, and concentrates.

Sample	pH ¹	H ₂ O ¹	Crude protein ²	Cellulose ³	Cell wall constituents	Neutral detergent fiber ⁵		Lignin ⁶	Acidity ⁷	In vitro dry matter digestibility ⁸
						Cellulose	Lignin			
Dec 1971	4.5	71.5	12.5	51.7	32.5	18.5	14.0	50.5	80.1	
Nov 1971	4.3	68.5	12.5	51.7	32.5	18.5	14.0	50.5	80.1	
Concentrate	4.5	71.5	12.5	51.7	32.5	18.5	14.0	50.5	80.1	

¹Acidity values for the silages and concentrates are given in % of dry matter.

mixtures matures more rapidly than the oat component of oat/pea mixtures. Therefore, barley/pea silage can be ensiled at higher dry matter contents at similar dates of planting and harvest than oat/pea mixtures with less dependence on field wilting of the crop prior to ensiling. Higher dry matter in silage is desirable during the long, cold winters of Alaska because it will reduce the possibility of the silage freezing into a solid mass. This is especially true of the large tower silos being used on many Alaskan dairy farms.

The barley/pea silage remained warm in the silo throughout the duration of the feeding experiment in contrast to the oat/pea silage which became progressively colder. On 11 January 1972, when outside air temperatures had been -30°F and lower for two consecutive days, the temperature of the barley/pea silage at one foot depth was +68°F. At the same time the oat/pea silage was frozen solid. The temperature of the barley/pea silage increased very rapidly when it was removed from the silo and the silage moulded to an inedible state within 24 hours. If fed as it was removed, however, it retained its feeding value and was palatable to the dairy cows on the trial. Although it heated in the silo and maintained high silage temperatures relative to air temperatures, the barley/pea silage appeared to retain a nutritive value comparable to that of oat/pea silage.

Both silages were sampled at weekly intervals throughout the experiment and individual samples were analyzed in the laboratory. The pH (a measure of acidity) of the oat/pea silage ranged from 4.0 to 4.8, indicative of satisfactory fermentation and good quality silage. The pH of the barley/pea silage ranged from 4.3 to 8.7. Values in excess of 8.0 were attained at three samplings in December and are indicative of very undesirable fermentation and poor quality silage. Other chemical analyses of the barley/pea silage, however, revealed the same degree of variation from sample to sample that was found with the oat/pea silage samples.

Heating in the silo during the cold

(Continued on page 26)

Barley Yields on Summer-Fallowed and Stubble Land

FRANK J. WOODING
Assistant Professor, Agronomy
CHARLES W. KNIGHT
Agronomy Lab Technician

Summer fallowing is a farming practice that involves keeping the land free of a crop for one year and controlling weeds with tillage or chemicals. The primary purpose of fallowing is to accumulate moisture and available nutrients in the root zone for the following crop. Summer fallowing is most commonly practiced in dryland agricultural regions receiving small amounts of total precipitation, particularly where rainfall during the growing season is unreliable and often negligible. For example, winter wheat is frequently grown in a wheat-fallow-wheat sequence in the Great Plains of the United States. Similar cropping sequences are widely used for production of spring cereals (wheat, barley, and oats) in parts of Canada.

In 1972, a preliminary investigation was conducted at the Fairbanks Research Center to determine possible benefits from summer fallowing in a farm program centered around production of spring barley. A field of bottomland silt loam soil was selected for the experimental site. Prior to 1971, the field was used for production of oat-pea silage. In 1971, the field was divided into two parts: half was planted to Edda barley and half was summer fallowed. During the 1971 growing season, the fallowed area was disked twice for weed control. The following spring equal amounts of fertilizer (250 pounds per acre of 10-20-20) were applied to the stubble and fallowed areas and disked in. Both areas were planted to Edda barley. Weeds were effectively controlled with a post-emergence application of 2,4-D herbicide.

Figure 1.

Dark green barley (right) growing on fallowed land, exhibited vigorous growth compared to spindly, light-green to yellow barley growing on stubble land (left).



Within three weeks after the seedlings emerged there were marked differences in plant growth and coloration between the two plots. Barley grown on fallowed ground had a dark green color and exhibited vigorous growth with many tillers per plant. In contrast, barley grown on stubble ground was light green to yellow in color and had short spindly growth with few tillers per plant. (Figure 1). Shortly after completion of heading, pronounced differences in size of developing grain heads became apparent. Grain heads of barley grown on fallowed land were almost double the size of those grown on stubble land (Figure 2).

Table 1. Barley yields on summer fallowed and stubble land, Fairbanks Research Center, 1972.

Treatment	Total dry matter yield (tons/acre)	Grain yield per acre	
		Tons	Bushels
Summer Fallow	4.67	2.12	88.3
Stubble	1.11	0.51	21.3

Yields of total dry matter (grain plus straw) and grain are reported in Table 1. The two soil management treatments resulted in substantial differences in productivity. Fallowed land produced barley yields that were approximately four times greater than those obtained from stubble land.

Soil and plant samples were collected at two-week intervals throughout the growing season. Analyses of these samples showed the most pronounced differences occurring in nitrate-nitrogen levels of soils and total nitrogen contents of plant tissues, particularly during early stages of growth (Table 2). Small variations were apparent in other plant nutrients but those differences were considered minor compared to nitrate, which has doubled in the fallowed soil, resulting in almost twice as much nitrogen absorbed by plants.

Table 2. Effect of fallowing on nutrient concentrations in soils and plant tissues. Samples collected 8-28-72. Concentrations shown as parts per million.

	Soil (0-8" depth)				Plant Tissue		
	NH ₄ -N	NO ₃ -N	Avail. P	Exch. N	N	P	K
Summer Fallow	13	18	44	80	29280	3000	22900 ppm
Stubble	12	8	22	70	15880	2300	17500 ppm

Soil moisture was determined but did not appear to be a significant factor in crop response. Melting snow left the soil saturated in the spring, and moisture differences between the two treatments could not be detected until deficiency symptoms became apparent in the seedlings. At that time, soil moisture correlated with crop demand and less moisture was found in the soil producing the most vigorous plant growth.

Considering plant and soil analyses and visible deficiency symptoms exhibited by the plants, limiting soil nitrogen was concluded to be the variable most responsible for reducing barley yields on stubble soil.



Fig. 2. Tall vigorous plants with large developing grain heads characterize barley growing on fallowed land (right).

It is recognized that rates of organic matter decomposition and soil microbiological activities are greatly reduced in the cold environment of northern soils. The practice of fallowing, which leaves the soil bare and exposed to the sun, obviously creates conditions more favorable for organic matter decomposition and soil nutrient accumulation.

Numerous questions arise which emphasize the need for further investigations in these areas:

- 1) Could these nutrient differences be overcome with additional fertilizer applications on stubble soils?
- 2) Would such practices be economically feasible?
- 3) Are spring applied fertilizers released rapidly enough in cold soils to meet crop demands?

Research is currently being planned which will attempt to answer these and other related questions. At present, however, the practice of summer fallowing appears to offer certain advantages for small grain production under subarctic conditions. ■

WHEAT RESEARCH IN ALASKA

R. L. TAYLOR
Research Agronomist

World wheat acreage and production, concentrated in the northern hemisphere, exceeds that of any other grain crop. It provides the principal food for almost one-third of the world's people.(6) This valuable crop also provides high quality feed for livestock. Since many farmers in Alaska have had experience with wheat production in other areas, the Institute of Agricultural Sciences frequently receives requests for information concerning this crop. Many years of continuing research have contributed to our knowledge of the performance of wheat in Alaska. In spite of limitations imposed by the environment, promising results warrant continued efforts to provide suitable wheat varieties for Alaskan production.

It is likely that the Russians attempted the cultivation of wheat during their occupation of Alaska, although substantiating records are lacking. The Russian fur trading companies who established settlements along the coast were required by their government charters to promote agriculture, among other things. Available evidence suggests that this requirement was not followed with great enthusiasm, the principal agricultural activity being the introduction of livestock as a source of food. Dall(4) indicates that barley and oats had been successfully grown in the Cook Inlet area during the Russian period, but wheat is mentioned only as a crop that probably could be grown. Evans(8) mentions reports that rye, oats, barley, and buckwheat were cultivated by the Russians at Yakutat and along Cook Inlet, but in 1897 he could locate no traces of cultivation. He reported observing wheat growing at Tyonek that year, and noted that wheat had matured at Sitka in 1896.

Georgeson(5) has reviewed the early history of wheat research in Alaska. Starting with the establishment of an experiment station at Sitka in 1898, wheat research continued at Kodiak, Kenai, Copper Center, Rampart, Fairbanks, and Matanuska, as experiment stations were opened in these areas. Despite successful wheat harvests for a few years, it was concluded that environmental conditions were unsuitable for grain production at Sitka, as well as at Kodiak and Kenai. Successful wheat

production was demonstrated at Rampart, Fairbanks, and Matanuska, with marginal success at Copper Center. Cool temperatures and excessive moisture, particularly at harvest, were cited as the most common environmental problems. Early fall frosts frequently damaged wheat at Copper Center.

Early experimental work consisted largely of testing introduced material, with some attempt at selection within mixed populations obtained from other areas. The major problem was immediately recognized as late maturity, and early-maturing material from Russia received special attention. A line identified during this early testing program, known variously over the years as Khogot, Chogot, or Siberian No. 1, remains today the major source of earliness. A small, thriving flour industry, started in the Fairbanks area in 1921, was reported in 1929(2) to be milling an average of 15 tons of flour annually. Local production of Khogot wheat supplied this industry. However, the 1928 report (1) indicated that production of wheat had declined in favor of growing oats for forage. Reliable records of crop production for these years do not exist, but the period between 1921 and 1928 probably represents the peak of wheat production in Alaska to date.

A breeding program involving hybridization between selected wheat parents was initiated in 1912 at Rampart by G.W. Gasser(5). Khogot was one parent in many of these early crosses, and late maturity was cited as the most serious problem. For various reasons, including the closing of the Rampart Station in 1921, no material survives from these early breeding efforts.

The present wheat program began about 1949, when an expanded agricultural research effort began in Alaska, after a period of minimal activity during the previous two decades. At this time, Khogot was still being grown to a limited extent in the Matanuska and Tanana Valleys. Among the wheat materials available at the Matanuska Research Farm were a number of bulk hybrid populations from crosses made about 1940 at the Fairbanks Research Farm. A relatively early selection from one of these populations, representing a considerable agronomic improvement over Khogot, was named Gasser and



released in 1953(7). However, this new variety did little to reverse the rapid switch from wheat to barley that had taken place with the availability of Edda barley to feed producers(3).

Preliminary to the reestablishment of a wheat breeding program, some 7,000 entries from the U.S. Department of Agriculture World Collection of wheat were grown in 1952 and 1953 at the Matanuska Research Farm. Any material showing promise was also tested at the Fairbanks Research Farm. A large number of outstanding strains were identified, however, one major problem remained. We had failed to locate any wheat that was as early as Khogot. The new breeding program, therefore, started with the same genetic source of earliness that was used at Rampart in 1912 without conspicuous success. Gasser, while agronomically superior to Khogot, follows the same maturity pattern. Likewise, several more recent selections from our breeding program represent improvement in agronomic characters, but they remain in the same maturity range. In spite of the superior feeding quality of wheat, in comparison with the more commonly grown barley and oats, it is unlikely that these new selections will yield enough to compete directly for the feed-grain acreage in Alaska. Within this material, however, may be strains significantly superior in performance to Gasser, which could find a somewhat limited, but increasing, market for use in home-processed food products.

Several unsuccessful approaches have been attempted in our efforts to locate earlier maturity in wheat. Testing of introductions continues, including growing an International Wheat

(Continued on page 25)



Figure 1. (left) Native plants offer real potential for conservation and agricultural purposes in the North. Native Bering hairgrass, shown here in an Institute nursery near Palmer, will be used on Amchitka Island to revegetate scars caused mainly by construction activities in connection with underground nuclear tests.

Using Native Plant Resources for Conservation

Wm. W. MITCHELL
Professor of Agronomy

An ethic is gaining force in our land that tempers our involvement with nature. We must rely on the resources of nature, and at times drastically alter parcels of its landscape, if we are to live. But an increasing sense of obligation toward restoration influences our conduct of these activities. Good management practices require efforts at rehabilitation, yet aesthetics alone can also be a powerful motive for such efforts.

Thus, on Amchitka, an isolated Aleutian island that appears destined to receive only occasional visits by relatively few persons, the Atomic Energy Commission will revegetate scars incurred there during the nuclear testing program. Most of the scars were not caused by the three underground nuclear tests. Little damage resulted from these. Drilling operations, road maintenance, and other construction activities produced the major disturbances, which in most cases were small in area.

Before rehabilitation could begin, research was necessary to determine materials and management procedures necessary for establishing a plant cover. No previous experience was known to us that could serve as a guide for



Fig. 2. Bering hairgrass was one of the better, consistent performers in all tests conducted on Amchitka Island. On the site above, near the location of the last underground nuclear explosion (termed Cannikin), the hairgrass is indicated by the arrows.

plantings in a maritime tundra situation such as this. Furthermore, the U.S. Fish and Wildlife Service, custodian of the island (it is part of the Aleutian Wildlife Refuge), has been reluctant to permit the introduction of exotic species into the area. This requires, then, the employment of plant materials indigenous to the region, or if introduced, of the same species occurring there. Hence, a comprehensive research program on native plant materials underway at this Institute found application in the investigation of this problem.

Prior to commencing plot work on Amchitka Island, a survey was

conducted of the natural revegetation processes and the species involved. The native plants on the island were determined to be poor seed producers, much too poor to supply sufficient amounts for reseeding the acreage involved. However, it was noted that two of the principal colonizers on disturbed sites were red fescue (*Festuca rubra*) and Bering hairgrass (*Deschampsia beringensis*). Fortunately, research has been in progress on the two species at our agricultural institute. Both introduced varieties and native collections of red fescue and native material of the hairgrass have been entered in extensive experimental programs; therefore, previous knowledge had



Fig. 3. This hairgrass harvester severs a shock of flowering culms with a scythe. Young seedlings of the hairgrass are colonizing the bare areas between the older plants.

been gained of their adaptive features and probable seed sources.

Amchitka rehabilitation

A number of grasses and a few legumes were tested on various sites on Amchitka Island in 1971 and 1972. A timothy, certain varieties of red fescue, meadow foxtail, and the experimental hairgrass were superior in performance to the other plants tested (Fig. 2). The fescues and hairgrass, being conspecific with native plants on the island, are favored for use in the restoration project.

Problems of seed supplies may limit the utilization of plants best adapted to these far northern latitudes. Some of the most successful plants are little used in other regions; thus, there are few seed growers and shortages develop. Fortunately, the red fescues found best adapted to Amchitka Island are obtainable from commercial sources. But the Bering hairgrass is another matter. It is still an experimental grass and no commercial sources of seed have been developed. To include it in the planting effort planned for this year (1973), it was necessary to obtain seed from native stands.

In the system of classification adopted for grasses (including cereals),

hairgrass is placed in the same tribe with oats. It occurs throughout the state of Alaska, but the particular type used in the trials on Amchitka is a coastal form. Individual plants grow as a tall, coarse bunchgrass with a long, diffuse inflorescence (flowering head). Bering hairgrass occurs on tideland flats and meadows along Alaska's southern and southwest coast. Some large populations of the grass have been located during our investigations. Late last summer, seed was collected from these populations by the laborious method of cutting seed stalks by hand (Fig. 3), sacking them and bringing them back to the Institute facilities at Palmer to be threshed with a small research-plot combine. After this coarse threshing, the seed was cleaned by a system of screening and blowing. Finally, about 400 pounds of clean seed resulted from these efforts. About 1.4 million seeds are required for a pound, thus over a half billion seeds are contained in the 400 pounds collected last summer. The plants from which the seed was collected will continue to produce in future years. Thus, a renewable native grass resource is being used for a constructive purpose.

Since native plants offer real potential for conservation and agricultural

purposes in the North, there are good reasons to further research work on this material. The hairgrass, for instance, shows potential for use in other regions, both as a conservation grass and a forage grass. In view of this potential, a program is underway to select plants superior in production and winter hardiness (Fig. 1).

Arctic rehabilitation

In addition to the Amchitka project, work is also in progress in the Arctic to determine if native plants may serve a role in rehabilitating oil field disturbances. The very severe climate and short growing season of the arctic coastal region are particularly limiting to the growth of the more conventional plants. A number of native arctic plants have been collected for research and development at the Palmer Research Center. Seed of these plants is being increased there so that additional trials may be conducted in our arctic investigations. Selections of individual plants are being made for increased seed production and more vigorous growth. Should some of these selections prove worthy of application they would be processed for release to commercial growers. Thus, it is hoped that they will serve a useful purpose and provide a source of income for local growers. ■

(Continued from page 23)

Nursery annually to keep abreast of wheat developments from all over the world. We have concluded that the early maturity we require is probably not available through introductions from other areas. However, we continue to look for other improved agronomic characteristics. Our first efforts to develop a new source of earliness involved mutation breeding, with treatment by x-rays, thermal neutrons, and chemicals. Although many different, extremely interesting mutations were observed, early maturity beyond that already available was not located.

Our current breeding effort to develop early maturity in wheat is based on the genetic principle of transgressive segregation. If wheats differ in genetic factors determining maturity, it should be possible to select, from progeny of crosses, material that is earlier than either parent. Our current program involves repeated recombinations of the earliest material selected in each generation from crosses within populations, starting with eight

Scandinavian varieties with excellent agronomic performance. Another population, started by crossing each of these varieties with Gasser, is also being used. They were chosen because, in contrast to most wheat introductions that head at about the same time as Gasser, they tend to head later than Gasser. Their kernels, with superior quality, develop in almost the same time as do the smaller kernels of Gasser. We are still several years away from obtaining material with the desired earliness, but initial results indicate definite progress. If we are successful in obtaining extremely early types, we will still probably be some time away from complete success, since selection for other characters has been suspended in these populations while we concentrate on early maturity. Additional work will be necessary to develop strains which are satisfactory in all agronomic characteristics.

Current wheat production in Alaska is almost nil, since wheat was supplanted as a feed crop by improved varieties of barley and oats. Nevertheless, we feel that a suitable, adapted wheat would be a valuable contribution to agriculture.

Continued research should lead to varieties that will mature dependably in many areas of Alaska, yield competitively with other feed grains, at least on a feed-quality basis, and fill a feed requirement in situations where barley and oats are not particularly desirable. An expanded local market for home-processed wheat for food may lead to small commercial enterprises, although large scale commercial ventures are not foreseen under present economic conditions. ■

REFERENCES

1. Alberta, H.W. 1929. Report of the Alaska agricultural experiment stations for 1928. Alaska Agricultural Experiment Stations Report.
2. Alberta, H.W. 1930. Report of the Alaska agricultural experiment stations for 1929. Alaska Agricultural Experiment Stations Report.
3. Andrews, Richard A., and Hugh A. Johnson. 1956. Farming in Alaska. Alaska Agricultural Experiment Station Bulletin 20.
4. Dall, William H. 1870 Alaska and its resources. Lee and Shysord, Boston.
5. Georgeson, C.C. 1926. Cereal growing in Alaska. Alaska Agricultural Experiment Stations Bulletin No. 6.
6. National Academy of Sciences. 1972. Genetic vulnerability of major crops.
7. Taylor, R.L., and J.C. Brinsmade. 1955. Gasser wheat. Alaska Agricultural Experiment Station Circular 21.
8. United States Department of Agriculture. 1898. A Report to Congress on agriculture in Alaska. Office of Experiment Stations Bulletin No. 48.

Rotary Plow Gives Yeoman Service

Wm.W. MITCHELL
Professor of Agronomy

LEE ALLEN
Associate Agricultural Engineer

A heavy-duty rotary plow, introduced into Alaska and given limited trial in 1971, underwent a rigorous practical test during the 1972 season. The plow was obtained by the Institute of Agricultural Sciences to conduct research on rehabilitation of disturbed grounds with support provided by the Alyeska Pipeline Service Company. During 1972 it operated on lands in the Matanuska and Susitna Valleys and on the Kenai Peninsula.

The plow was used on several fields that had been cleared during the winter. Trees and brush had been sheared off while the ground was frozen leaving stumps exposed at surface level. Spruce stumps 10 to 15 inches in diameter were fragmented by the whirling tines. The machine was effective in eliminating much of the laborious root picking often necessary after land treatments by more conventional means (Fig. 1). However, a final discing or other form of land treatment was desirable for leveling and preparation of a better seed bed. The plow was also operated on stump rows that had been burned, and on fields that had been abandoned and were overgrown with brush and young trees. An abandoned brome grass field that supported a considerable growth of willow, birch, and poplar was rotary plowed, worked with other equipment, and replanted to brome grass in sufficient time for an adequate first-year stand to develop.

Fourteen different farmer-cooperators rented the machine in the Matanuska Valley to till about 250 acres. The plow also continued work commenced in 1971 along the Anchorage-to-Fairbanks highway in the Susitna Valley. A total of 16 miles of right-of-way were prepared for seeding by the rotary plow along the new highway.

On the Kenai Peninsula about 20 acres of grassland were tilled near Homer on a newly acquired site for a branch station of the Institute. Forty-four acres of similar cover were plowed on private property in that vicinity. Four farmer-cooperators rented the machine in the Soldotna/Kenai area to till 62 acres and about 8 miles of right-of-way were worked along the Sterling Highway east of Soldotna.



Fig. 1. This bottomland southeast of Palmer had been cleared of a mixed stand of spruce, cottonwood, and brush in the winter. It included some large cottonwood and spruce 10-15 inches in diameter at the base. Effect of rotary plow is seen at left.

The lush native grasslands on the Kenai Peninsula and Kodiak Island have confronted ranchers and farmers with a difficult problem. Preparation of these grasslands for harvest or planting has required the expenditure of tremendous time and effort in reducing the hummocks that have developed in the rank growth. Without considerable smoothing, it is impossible to negotiate the fields with ordinary harvesting equipment. Furthermore, if fertilizer applications are to be effective on this ground, the deep surface accumulation of litter and humic material must be worked into the soil. The rotary plow proved to be the most effective machine yet found for handling this situation. It eliminated the hummocks and incorporated the surface organic matter in one operation. Further research is needed, however, to determine proper management procedures to promote native grass regrowth, or, alternately, to prevent the regrowth when it is desirable to establish another crop.

The roto-tilling action of the plow does present a difficulty for subsequent activities on agricultural land. It leaves a loose, fluffy plow layer, particularly when the soil is dry, that is difficult for equipment to negotiate. Also, this layer is subject to excessive drying at the surface. Packing or other methods of settling may be necessary to prepare a good seed bed.

The extremely long winter delayed the start of operations in 1972, and initial efforts were conducted on land with frost at a shallow depth. When

riding on frozen ground the tines of the rotor were worn severely and provided reduced hours of service. Gravelly and rocky ground, often encountered in highway right-of-way use, was particularly punishing to the tines. However, in ordinary, unfrozen ground the tines provided over 200 hours of service.

Cost of land preparation using the rotary plow has generally been lower than that encountered using more conventional methods. The fact that most land types can be seeded with only light working after one pass with the rotary plow contributes to the reduced cost. Additionally, the production of a crop in the year of primary tillage provides the farmer a quicker return on his investment. Under normal conditions the plow can prepare several acres of land per day. The average rate of tillage as monitored on 460 acres of light to heavy cover was 1.1 acres per hour. ■

BASIL BENSIN DIES AT 91

Basic Mitrophanovich Bensin, retired agronomist and educator, died in February at Raleigh, North Carolina. He was born in Russia in 1882, and had done agricultural research work there, in Czechoslovakia and the United States. He worked for a time at the Alaska Agricultural Experiment Station (now the Institute of Agricultural Sciences) at Fairbanks.

Bensin had formerly lived in Farmingdale, N.J., but moved to Raleigh in 1968 to be near his sons, Igor Basil Bensin and Dr. Vladimir Basil Bensin. Also surviving are a sister, Mrs. Kathryn M. Pepeskul of Miami, Fla., and four grandsons.

The funeral was held at St. Vladimir's Memorial Church, Cassville, N.J., and he was buried in St. Vladimir's Russian Orthodox Christian Cemetery.

COMPARISON (Con't from page 21)

Alaskan winter is not undesirable if it permits easy removal of the silage in comparison to frozen silage. However, the energy consumed in heating can be expected to come from the silage itself and should lower the total energy value of the remaining material. Certainly more research is indicated to provide further information on the use of the new barley variety (Weal) in annual forage mixtures for silage. ■

REFERENCES

1. Brandt, A. E. 1938. Tests of significance in reversal or switchback trials. Iowa State College of Agr. and Mech. Arts. Research Bulletin 234.
2. Taylor, R. L. 1972. New cereal varieties for Alaska. *Agroborealis*, Vol. 4, No. 1, p. 27-28.

New Potato Varieties for Diversification and Specialized Markets

CURTIS H. DEARBORN
Research Horticulturist

Alaskan potato growers should be able to increase their income by growing new potato varieties developed specifically for Alaska. These new varieties are competitive with imports in skin color, mealiness of baked product, and suitability for manufacture of potato chips and french fries. They include two new clones being increased this season for release to growers for the 1974 planting season, and Alaska Frostless released in 1969. Clone 37 is a high-yielding potato with dark red skin, and Clone 35 has many of the characteristics needed in a potato for processing into potato chips and french fries. Alaska Frostless, as the name implies, is quite tolerant of field frosting of the tops and in addition the crop can be grown without "ridging" or "hilling."

Red-skinned potato

A market exists in Alaska for several hundred tons of red-skinned potatoes ("reds"). Because reds are available from Florida in March and April, Alaskan merchants have become accustomed to promoting these under the label "new reds." These are frequently priced between 17¢ and 24¢ a pound, an unusually high price for potatoes. In the past, Alaskan growers have ignored this red potato market for two reasons. It has been largely a seasonal market promoted by sales outlets instead of growers; more important, red-skinned varieties formerly available for production in Alaska lacked quality or yield of saleable tubers as compared with white-skinned varieties ("whites").

Clone 37, a new variety bred and selected at the Matanuska Research Farm, should broaden growers' opportunities. Clone 37 is high yielding, with good culinary quality. The smooth, oval tubers with shallow eye basin and dark red skin are very attractive. In a 3-year yield test with other reds, including 'Chieftain' and 'Red Beauty,' Clone 37 averaged 340 cwt of U.S. No. 1 per acre. This was 43 cwt more than Chieftain and 120 cwt more than Red Beauty. Clone 37 exceeded all other reds in percentage marketable tubers and in total solids content. In fact, it yielded 10 percent more marketable tubers than any of the whites tested. Clone 37 has remained in good condition in both

common and refrigerated storage from harvest to the next planting season. Rough handling at harvest causes considerable skin "feathering" but the bruises suberize readily. Seed-piece decay of untreated seed of Clone 37 in cold, wet soils seems to be greater than that of most white varieties. Seed-piece decay may not be a very serious matter in most seasons; however, it is a good practice to use a seed treatment to protect cut-seed of Clone 37. So far, scab has not been serious on the tubers. Foliage diseases have not been observed on Clone 37 but this is not unusual in this clean environment.

Processing potato

Several million pounds of potatoes are presently being imported into Alaska as frozen French-fries, and carloads of whole fresh potatoes are shipped for chip manufacture. Potatoes for these purposes must be high in starch and low in reducing sugars and must have a low peel loss in preparation for processing, and they must retain these qualities from harvest until they are processed. Thus, for a portion of the crop which will be in storage for nearly a year, special production and storage conditions are necessary to preserve these inherently desirable qualities. Ideally, one should be able to store potatoes at 33° to 40°F and process them directly from storage. Unfortunately, these characteristics have not been combined yet in a potato variety although considerable progress toward this goal has been made both here in Alaska and in other states.

Our potato breeding program at Matanuska for the past 12 years has been focused on developing varieties suitable for Alaska production and processing. Over 100,000 seedlings have been grown, stored, and noted; and those apparently desirable for processing have been chipped, French fried, and baked to determine their usefulness.

Although the emphasis in this work has been on developing a potato for processing, experience has shown that a processing-type potato must yield at approximately the same rate per acre as varieties grown for the fresh market. Otherwise, in seasons when some growers' potatoes could not meet the processors' requirements, the growers' income would be reduced if they could not compete on the fresh market. Grower rejection in 1968 of Clone 90,

an excellent quality potato for chipping, rested on the fact that its yield was 25 per cent less than that of varieties being grown for the fresh potato market.

Clone 35, a new white-skinned potato selected in 1968 from among seedlings of a cross of 'Ontario' x 'Stately', has many of the characteristics desired in a processing-type potato. Its tubers are oval and relatively uniform in size and have shallow eyes and stolon cavity. Clone 35 has a 3-year average of 308 cwt per acre of U.S. No. 1 tubers 2 to 3.5 inches in diameter; 'Alaska 114' has an average of 303 cwt per acre and Kennebec has an average of 274 cwt per acre. Total solids content of Clone 35 significantly exceeded that of either Alaska 114 or Kennebec. The high yield and high total solids content of Clone 35 should allow Alaskan growers of this new variety to compete for sales in either the fresh or processing market outlets.

Very light, crisp, flavorful chips have been made from this new variety for the past three crops. Chip appearance and quality have remained fairly constant from potatoes stored at 50°F and sampled monthly or more often for 6 months (September-March). Storage of Clone 35 at 50°F resulted in sprouting after mid-December, so a sprout inhibitor would be needed to control profuse sprout growth that developed by mid-January. In other studies⁽¹⁾ tubers from field plots sprayed with maleic hydrazide were stored for 11 months at 46°F and remained in good condition throughout the period. We can reasonably believe that Clone 35 would respond similarly if sprayed in the field with sprout inhibitor, maleic hydrazide.

Level culture potato

'Alaska Frostless,' a new variety released in 1969, illustrates a built-in genetic response to the environment. This response can be a real advantage to potato growers but was not recognized when the variety was released. In addition to being quite resistant to field frosting, stolons of Alaska Frostless continue to grow downward in the soil until the tuberizing stimulus from the tops cause stolon elongation to cease and tuberization to begin. In this variety, this delay in tuberization results in tuber formation in the soil well below the usual depth for other varieties. As a consequence of this deep location of tubers in the soil, light that causes

(Continued on page 29)

Controlling Alaskan Insects Without Chemicals

RICHARD H. WASHBURN
Research Entomologist

The insects affecting agriculture in Alaska are diverse and widely distributed, but most of the time they are controlled by naturally occurring parasites, predators, viruses, bacteria, and fungi. Moreover weather conditions are often more favorable to the insect enemy than to the insect. As a result, gardeners and farmers in Alaska do not have to worry about many insects.

The turnip maggot which attacks members of the cabbage family, and the reindeer warble fly, which is numerous in reindeer and caribou, are the two species of insects in Alaska that are little affected by natural control agents. However, populations of turnip maggot can be reduced by crop rotation and prompt destruction of crop residues before the maggots have a chance to pupate. Also, the destruction of weedy mustards will eliminate another source of maggots.

When such methods are used, populations may be reduced so treatment with insecticide can be minimized. While a control of 95% in a population of 100 maggots in a 100-foot row will allow a good crop of radishes to be produced, the same degree of control in a population of millions will allow enough infestation to make a crop of radishes unmarketable. Of course, the home gardener may not have space available for crop rotation, but he can still benefit from prompt destruction of cabbage roots or radishes that are no longer edible.

Also, the flat yellow-fleshed varieties of turnips ('Petrowski' is the best known example) are not as heavily attacked as the round white-fleshed types such as 'Purple Top White Globe' or 'Tokyo Market'. This difference is evident when the two types are planted near by, but when Petrowski is planted by itself and no other crucifer is available it will be heavily infested. Probably 'Petrowski' is not truly resistant but is merely less attractive to adult egg laying maggots.

Cutworms

An excellent example of the sporadic type of insect problem that is more common in Alaska is provided by the cutworm complex. One of the greatest outbreaks occurred in 1943 and resulted in widespread destruction of vegetables. One grower reported seeding cabbage eight times before he got a stand; each time the plants

emerged they were eaten off at ground level. The only benefit from this outbreak was the elimination of weeds by cutworms in some potato fields. Numerous outbreaks of cutworms have occurred since—at 5 to 7 year intervals. The problems continue for a year or two after these peaks, and then the destructive species practically disappear.

The reductions in the peak populations of cutworms are caused by several agents. The most spectacular contributors appear to be parasitic wasps called Ichneumon flies that belong to the genus *Pseudoambylites*. These parasites emerge from the larvae of the red-backed cutworm, our most destructive species, and they can be observed skimming along the ground searching for cutworms. Another agent is a disease classified as a granulosis polyhedrosis virus. It appears to be the principal disease in populations of Alaskan cutworms and in some outbreaks is an important factor in reducing populations of cutworms. Unfortunately, the blacklight traps that serve to indicate cutworm populations and attract many adult cutworms in other parts of the United States, do not attract the species that are of economic importance in Alaska. Our most destructive species have their flight and egg-laying period in maximum daylight, so light traps are not effective from mid-May until mid-July. Also the cool evening temperatures in Alaska, compared with those of the mid-western states, cause diminished night flight and few light-trap collections.

Aphids

Populations of aphids also fluctuate greatly from year to year, though they are usually under tremendous pressure from parasites, predators, and disease. Unfortunately, additional pressure by importation of ladybird beetles, preying mantids, and other predators is not a practical method of controlling an outbreak unless the aphids are infesting a crop in a greenhouse or the predator can be otherwise confined to the infested crop. The ladybird beetles simply disperse too rapidly. In one case, within just a few hours of release, none could be found in an area where birch were heavily infested with aphids.

Naturally occurring native predators, parasites and fungi do keep down the number of aphids despite the fantastically high rates of aphid reproduction. Drought conditions that

are unfavorable to the fungi will encourage the buildup of aphid populations, but also that of the predatory, bright-colored syrphid flies whose larvae are slug-like. Drought also increases the numbers of the minute parasites known as braconid wasps. For example, three years ago during one of our driest summers, large numbers of the potato aphid invaded commercial fields of head lettuce for the first time, but in the summer of 1972, it was difficult to find aphids outdoors except woolly aphids on a few stands of white spruce. Even bird cherry, which is the overwintering site for the oat-birdcherry aphid and is usually coated with aphids during part of every summer, had no aphids in the summer of 1972.

Temperature control

Our weather has other advantages in regard to insects. With few exceptions, the only problems with greenhouse insects occur in those structures that are operated year-round, since winter freeze does an excellent job of eliminating most insect problems. Indeed, Alaska has no present quarantine against the importation of infested plant materials from the other states. The careful grower can usually avoid problems by isolating any plant material until he can be sure there are no insects that may spread to material he has raised himself. However, the widespread infestation of the greenhouse white fly in a number of greenhouses has been traced to a single infested plant.

Even the so-called "stored-product" type of insects, including those in dry cereals and prepared mixes and flours, can be reduced by the use of high or low temperatures. Thus, freezers, ovens, and low outdoor temperatures in midwinter can be used to alleviate the problem. However, heating in an oven, though effective, must be carefully done or it may be as destructive to the contents as to the insect. A local feed supplier had no problems with insects until he decided to store the feed where the temperature would be more comfortable for the workers. Then a low-level infestation became a large one before the infestation was noticed. Of course, cold will not kill all stages of developing insects, but it will slow the rate significantly, and many species will be killed outright.

Our so-called hostile environment can therefore be put to good advantage

in controlling insects and reducing the use of insecticides. Moreover, the fewer insecticides we use, the greater are the opportunities for naturally occurring parasites, predators, and disease to keep insect pests at a low level. ■

PHOTOPERIOD (Continued from page 15)

treatments were started on August 25. Different sections of the grass rows were exposed to four different daily light/dark patterns for about eight weeks until freeze-up near mid-October. At that time, all above-ground growth of grasses had been killed by low temperature and the soil had begun to freeze.

Discussion of treatments will be simplified if, instead of specifying both the daylight and the darkness hours of each day, we refer only to the daily term of darkness, or nyctoperiod. Treatments during the eight weeks prior to freeze-up were (see Figure 1): NN = normally lengthening nyctoperiods (9 hours at start, lengthening to 15 hours in mid-October); IN = normal nyctoperiods except interrupted from midnight to 1:30 a.m. with artificial lighting; LN = lengthened nyctoperiods (15 hours daily), accomplished by shortening the daily photoperiod with a movable, light-tight structure; and SN = shortened nyctoperiods (9 hours daily), provided by extending the daily photoperiod with artificial lighting.

The first effect of treatments on the grasses appeared earlier than anticipated. About halfway through the 8-week treatment period, it became obvious that the different light/dark patterns were already influencing growth rates of the grasses. The most striking effect noted was the increased growth where nyctoperiods were interrupted (note height of grasses on measuring stakes in Figure 1). During the late summer and early autumn, when grasses ordinarily cease rapid topgrowth and begin preparations for winter, the continued vigorous growth induced by interrupted dark periods could predispose grasses to winter injury.

And indeed, that was the case. The following spring it was noted that where nyctoperiods had been interrupted each night for 8 weeks before freeze-up, grasses sustained most winter injury — some winter-killing completely.

In general, the Alaskan-adapted grasses survived best where they had been exposed to the normal, unmodified daily light/dark pattern prior to freeze-up.

In contrast, the midtemperate-adapted Southland brome grass (from Oklahoma) showed poor winter survival where rows had been exposed to the normal, unaltered subarctic daylight/darkness pattern prior to winter (Figure 2-Top). But note the good winter survival and vigorous growth of another portion of the same Southland row where it had been exposed to artificially lengthened (15-hour) daily dark periods for 8 weeks before freeze-up (Figure 2-Bottom).

Again we refer to adaptation. The lengthened-nyctoperiod treatment provided a daily light/dark pattern for a period before freeze-up more similar to autumn conditions in Oklahoma; under those artificially provided light/dark conditions, while temperatures gradually became colder, Southland was induced to undergo adequate preparation for winter. These results reaffirm the earlier statement that plants perform best when exposed to conditions to which they are adapted.

The four treatments prior to winter affected not only winter survival of the grasses but also the numbers of seed heads produced the following year. On the surface, this may seem somewhat surprising. However, earlier studies have shown that, in many grasses native to subarctic and arctic areas, the minute beginnings of seed heads (floral primordia) normally start forming in underground tillers during the growing season of the year before the one in which they will emerge as seed heads. Therefore, environmental conditions that influence the formation of grass seed heads are important in this subarctic area at least part of the year before the year that the seed heads appear. This is contrary to the pattern of development in more southern latitudes where most grass seed heads start to form in spring of the same growing season in which they emerge.

In our present study, the subarctic-adapted grasses responded differently in heading than did those from the more southern sources. The northern grasses produced most seed heads after exposure to the normal daily light/dark pattern to which they are adapted. The lengthened (15 hr.) nyctoperiods, which favored winter survival and seed-head production in Southland brome (Fig. 2), virtually prevented heading in the native Alaskan brome grass (Fig. 3).

Interrupted nyctoperiods were detrimental to seed head production of all grasses (Fig. 4). This adds to the growing scientific evidence that the duration of nights is of critical importance to a number of plant

processes at various stages of plant development and at different times of the year.

These results have emerged from continuing studies here on adaptation of crops, including phenomena affecting winter survival and seed production. Better understanding of the climatic as well as other factors that influence crop hardiness and reproductive ability will help us to devise scientifically based crop-management recommendations. These findings, correctly interpreted and applied, can contribute significantly to more efficient and enlightened agricultural progress in Alaska. ■

PRESERVING (Cont. from page 11)

From this brief analysis, the economic picture looks favorable for treating wood products in Alaska by the double-diffusion method. Further economic research on the double-diffusion method of treating wood products is in progress. One phase of the research will consist of a study to determine the current and potential market for treated wood products in Alaska.

However, remember that there are other factors, not the least of which is management, which largely determine the success or failure of any business venture. This is the meaning of "the slips twixt the cup and the lip." ■

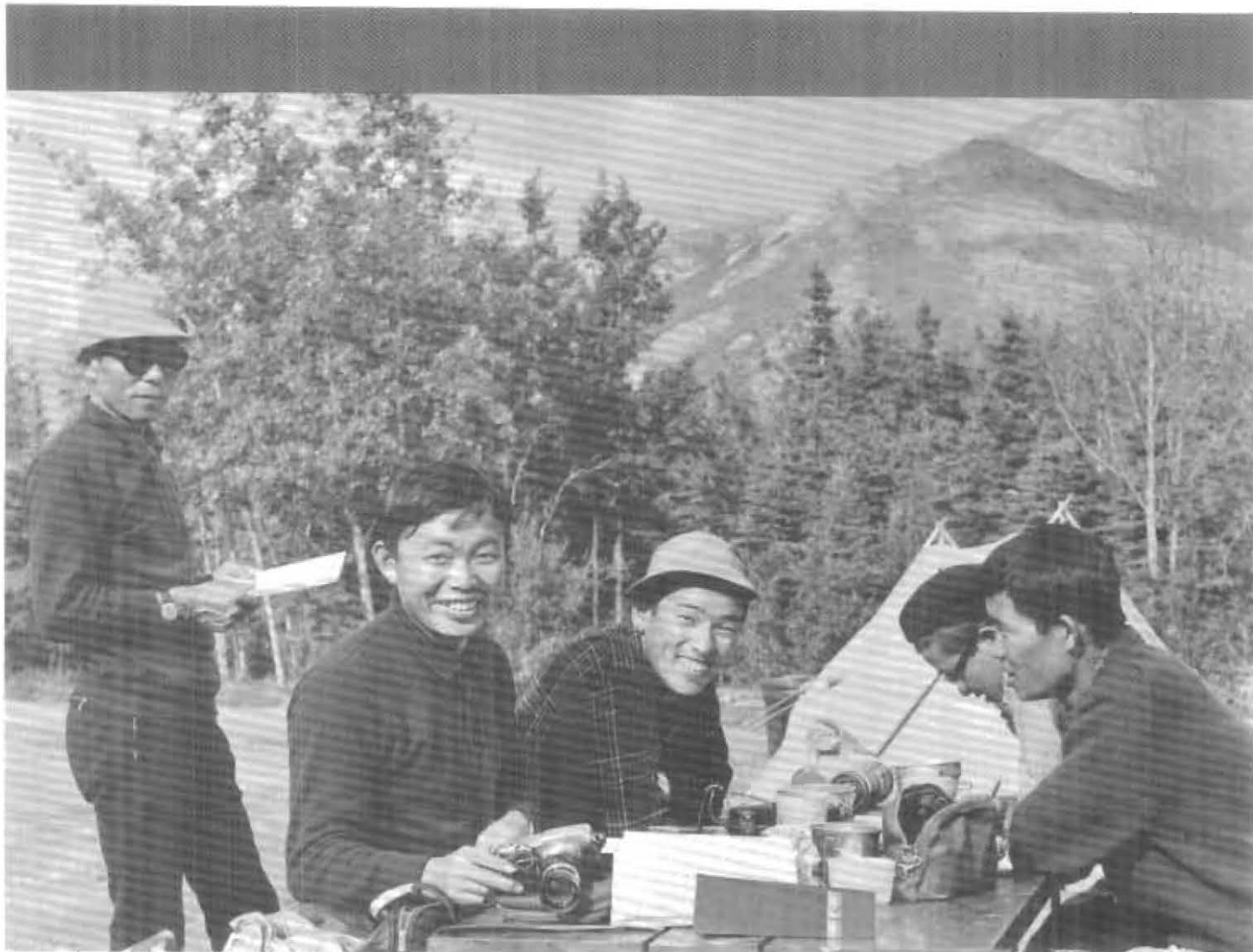
POTATO (Continued from page 27)

potato tubers to turn green and develop a bitter flavor never reaches them to produce this undesirable effect.

The significant part of this observation is that Alaska Frostless can be planted and grown in level culture instead of ridge or hill culture. Without the necessity for ridges and hilling, one can plant Alaska Frostless, use a chemical weed killer for weed control, and grow the crop to maturity with no tillage. For the home gardener this is a tremendous work saver. He must, however, realize that he will have to dig deep to unearth the potatoes. For the commercial potato grower "no tillage" culture permits high density planting, which is expected to produce higher yields per acre and will necessitate considerable modification of planting and harvesting machinery.

REFERENCE

1. Dearborn, C.H. 1963. Chemical sprout control of Alaska potatoes, and the influence of pre-storage washing and storage temperature on market quality. University of Alaska, Alaska Agricultural Experiment Station. Bulletin 33.



PRIVATE CAMPGROUNDS IN ALASKA

KIETH E. LOAN
Research Assistant

WAYNE C. THOMAS
Assistant Professor, Economics

With so much emphasis placed on revenue potential of oil development in Alaska these days, many of us have a tendency to forget an industry which contributed approximately \$66,000,000 to the Alaskan economy in 1972 and has the potential of contributing over \$100,000,000 annually by 1975. The industry is tourism. The Travel Division for the State of Alaska estimated that 182,300 tourists entered Alaska in 1972. Past studies conducted by the Travel Division

indicate that the number of tourists visiting Alaska increases each year at a rate of 18%. If this trend continues, we can expect 300,000 tourists to visit our state in 1975.¹

We at the Institute of Agricultural Sciences are interested in analyzing rural development possibilities in Alaska. An important sector of tourism in Alaska, which also has rural development implications, is the private and public campgrounds in our state. Camping has been an important aspect of the rural recreation experience in Alaska for many years. This rural orientation exists because Alaskan residents and tourists seem more interested in activities away from the metropolitan areas, and spend much of their vacation time in rural settings.

Thus, we feel that a study of public and private camping is of primary importance to the rural economy of Alaska. This is supported by the number of tourists who are potential campers — 66,300 of the 182,300 tourists who visited Alaska in 1972.²

In order to conduct an economic analysis of the campground market, we have identified three major objectives:

¹Data obtained from unpublished studies, Alaska Travel Division.

²Figures extrapolated from Alaska Travel Division information.

³Adapted from Northeastern Regional Marketing Project—42.

1. Evaluate pricing, marketing and management practices of private firms providing camping.

2. Determine the legal authority and policies which underlie the pricing and marketing decisions of public camping management agencies.

3. Determine the motivations, goals and characteristics of the camping public as a guide to development of a rational pricing system for public and private campgrounds in Alaska.³

Research on the first objective has begun with data collection and analysis of the private campground sector. Analysis of the remaining objectives will come after completion of objective one and are not reported here.

We used a questionnaire to interview the campground operators either by mail or in person. The questionnaire used for the interviews was designed to generate economic information on pricing and marketing policies, and on management decision-making within the private campground industry in Alaska. The information obtained will be analyzed and made available (in a manner so that individual private campgrounds cannot be identified) to everyone interested in this particular facet of rural development in the state.

In order to conduct the interviews, our first task was to arrive at a complete list of the private campgrounds in the state. Our list was developed from published

sources; the Alaska Division of Parks, and the Alaska Campground Association. Questionnaires were mailed to campgrounds in Southeastern Alaska where personal interviews were not attempted. We determined that in addition to the 57 privately owned campgrounds that charge fees, there were eight that are privately owned and allow free camping. During the interview period (Summer, 1972) three initial observations were apparent. Many people with trailers and mobile units preferred campgrounds with complete hookups of sewer, water and electricity. Also, selection of a campground strictly for locational convenience was common. Probably the most significant reason for choosing a private campground was the security afforded by someone being on duty at all times.

Only preliminary results of pricing characteristics and prevalent economic conditions existing within the industry can be presented at this time. To allow price comparisons, the campgrounds were grouped according to their capacity and the facilities available (Table 1). Regarding pricing methods, for the 25 completed questionnaires we found that 15 campgrounds had a per-site charge based upon the facilities provided: six charged a basic party fee and extra for each additional member; two charged on a per person basis; and two campgrounds based their fees on the type of vehicle.

Campground owners are faced with many problems that reflect the overall economic conditions of the industry. Two examples are the difficulties in obtaining financing for facility development and concern over possible competition from publicly operated campgrounds.

In addition, a major difficulty is that the Alaskan camping market is primarily transient; the campers usually stay at a campground for only one day and then travel on. Approximately 64 percent of the campground owners that completed our questionnaire indicated that the greatest portion of their business is made up of one-day campers. This mobility of tourist and resident campers in Alaska makes it more difficult to maintain a profitable level of occupancy.

We are still in the process of gathering and correlating data. Consequently, we feel that any in-depth interpretations would be somewhat premature. The information provided here is only intended to give you some insight into the type and purpose of our study. When completed, it should provide the campground operators with additional information to assist them in their decision-making processes regarding the economic issues of marketing, pricing and management. The private campground industry is an integral part of the entire tourist package, one that is increasing in importance each year. It is our hope to provide information that assists in its development. ■

Table 1. Preliminary average daily charge (dollars) at various campgrounds in Alaska, 1972*

Campground capacity (Number of sites)	Number of campgrounds in each group	Type of facility					
		Open field (no designated sites)	No hookups (designated site)	Elec. only	Elec. & water	Elec., water and sewer	Other combination
1-10	4	1.00	—	3.16	—	—	3.50
11-20	5	1.05	—	3.33	—	3.73	—
21-30	4	3.02	1.10	3.00	—	3.12	—
31-40	1	—	—	—	—	3.50	—
41-50	2	0.56	2.00	—	4.00	—	3.00
51-60	4	2.00	3.06	3.45	3.50	3.50	—
60 and over	5	2.18	3.00	—	3.78	4.00	—

*Calculation of prices in this table was based on the assumption that the average party size was three people.

PUBLICATIONS

Branton, C. I., L. D. Allen, and J. E. Newman. 1972. Some agricultural implications of winter sublimation gains and losses at Palmer, Alaska. *Agricultural Meteorology*, 10:301-310.

Branton, C. I., R. H. Shaw, and L. D. Allen. 1972. Solar and net radiation at Palmer, Alaska 1960-71. University of Alaska Institute of Agricultural Sciences Technical Bulletin No. 3.

Brundage, A. L. 1972. Repeatability of a two-stage in vitro system of digestibility measurement. *Journal of the British Grassland Society*, 27:111-114.

Dinkel, D. H. 1972. Flame violet—a house plant for Alaska's long winter, low light conditions. University of Alaska Institute of Agricultural Sciences Circular 28.

Dinkel, D. H. and A. C. Epps. 1972. 1973-1974 Vegetable varieties recommended for interior Alaska. Alaska Cooperative Extension Service Cooperative Publication No. 30.

Dinkel, D. H. and A. C. Epps. 1972. 1973-1974 Vegetable varieties recommended for southcentral Alaska. Alaska Cooperative Extension Service Cooperative Publication No. 31.

Dinkel, D. H. and A. C. Epps. 1972. 1973-1974 Vegetable varieties recommended for southeastern Alaska. Alaska Cooperative Extension Service Cooperative Publication No. 231.

Laughlin, W. M., P. F. Martin, and G. R. Smith. 1973. Potassium rate and source influences on yield and composition of bromegrass forage. *Agronomy Journal*, 65:85-87.

Marsh, C. F. 1971. Food prices in Alaska with supplemental cost of living data . . . 1960 to 1970. University of Alaska Institute of Agricultural Sciences and Alaska Cooperative Extension Service.

Marsh, C. F. 1972. Quarterly report on Alaska's food prices. University of Alaska Institute of Agricultural Sciences and Alaska Cooperative Extension Service.

Michalson, E., and W. Thomas. 1972. Economics of asparagus production and harvest mechanization in Washington. Washington Agricultural Experiment Station Bulletin 759. 12 p.

Thomas, W., L. Blakeslee, L. Rogers, and N. Whittlesey. 1972. Separable programming for considering risk in farm planning. *American Journal of Agricultural Economics*, 54:260-266.

Thomas W., and L. Rogers. 1971. Empirical investigation of relationship between expected income and income variability in firm decision making. *Proceedings, Western Agricultural Economics Association*, 82-86.

University of Alaska Institute of Agricultural Sciences Staff. 1972. A review of some research in progress. *Agroborealis* Vol. 4; No. 1.

University of Alaska Institute of Agricultural Sciences Staff. 1972. Agriculture is people. *Agroborealis* Vol. 4; No. 2.

Wooding, F. J., G. M. Paulsen, and L. S. Murphy. 1972. Sulfur composition of soybeans as affected by macronutrient deficiencies. *Communications in Soil Science and Plant Analysis* 3:151-158.

Wooding, F. J. and A. C. Epps. 1973. 1973-1974 Grain varieties for the Golden Valley. Alaska Cooperative Extension Service, Cooperative Publication 46.

